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EDITED BY: DONALD G. PATERSON, UNIVERSITY OF MINNESOTA

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Predicting Success in Machine Bookkeeping *

Edward N. Hay

The Pennsylvania Company, Philadelphia

The problem is to select from among experienced and inexperienced clerical applicants those girls who, after about a year's experience, prove to be rapid and accurate bank machine bookkeepers. In the past, there has been great variation in the amount of satisfactory work produced by different girls in an hour's time. For example, the extreme range in the last five years is from the slowest operator at 74 units of production per hour to the fastest at 153.

In 1937 a battery of tests was administered to the bookkeepers but it was not possible at the time to secure a satisfactory criterion. In 1941, after the criterion problem had been satisfactorily solved, another battery of 22 additional tests was administered, with excellent results.

Description of the Job

The job is the operation of the standard bank bookkeeping-adding machine. The debits posted are the checks cashed by the customer and the credits are his deposits.

A detailed time and motion analysis of the job is contained in Table 1, which shows that there are five distinct operations which may be broken up into 18 motions. It will be noted that this is a bi-manual job. This table also refers to the tests used which are listed by name in Table 3, some of which it was hoped would show good correlations with the criterion.

The Criterion

Considerable attention was devoted to the selection of the criterion, its measurement and its reliability. Other investigators have adopted

* Acknowledgments are extended to the following for critical comments on the design of this experiment and in the preparation of the manuscript: George K. Bennett, Marion A. Bills, T. J. Gorham, Roy B. Hackman, A. K. Kurtz and E. F. Wonderlic. The experiment itself was carried out with the assistance of the following, each of whom contributed substantially to the final successful result: Arline Mance Blakemore, Paul K. Fryer, Wm. D. Turner and Mary Elizabeth Hemsath Van Newkirk.

Table 1
Operation and Motion Analysis of Machine Bookkeeper

Operation No.	Operation	Avg. Time	Motion No.	Left Hand	Eyes	Right Hand	Tests Tried
1.	Select ledger card	1.3 sec.	1.	Rest	Look at cards	Search for card	1, 4, 5, 6, 7, 8, 10, 14, 16, 20, 22, 23, 25
			2.	Rest	Look at cards	Find card	
			3.	Move to carriage	Look at cards	Grasp card	
			4.	Rest	Move to carriage	Carry card	24
2.	Insert ledger card	1.1	5.	Grasp card	Line up card and guide	Position card	17, 20, 22, 23, 25
			6.	Insert card	Line up last balance	Insert card	
			7.	Return to keys	Read last balance	Move to carriage lever	2, 3, 9, 15, 18
			8.	Rest	Move to keys	Depress carriage lever	
3.	"Pick up" old balance	1.1	9.	Depress keys	Read keys	Depress keys	Same
			10.	Move to check	Read check	Depress motor bar	"
4.	Post check amount	2.2	11.	Grasp check	Read keys	Depress keys	"
			12.	Turn check	Read name next check	Depress motor bar	"
			13.	Release check	Read name next check	Move to carriage	"
			14.	Return to keyboard	Read name next check	Rest	"
			15.	Depress balance key	Read name next check	Rest	"
5.	Return card	1.1	16.	Rest	Move to carriage	Grasp card	"
			17.	Rest	Turn to tray	Carry card	"
			18.	Rest	Look for next card	Release card	"
		6.8 sec.					

an error score of machine operators as the most valid criterion of performance.[1] We have selected instead the speed of posting.

The relative value of a bookkeeper depends chiefly on the *amount* of satisfactory work turned out in a given period of time. Operators cannot be permitted to remain at work if they make many errors. Consequently they learn to work at that speed at which they make few or no mistakes.

As a matter of interest, the correlation of production records (shown in Table 5) with the corresponding error records is .02, and the corre-

[1] W. H. Stead and C. C. Shartle. *Occupational counseling techniques.* American Book Co., 1940. See pp. 147, 149 for a study of 52 bank bookkeeping machine operators. The criterion used was "per cent efficiency scores computed from errors," etc., and a multiple correlation coefficient of .45 was obtained with five tests.

lation between Otis scores and errors is .11. This error score was not, however, made up in the same manner as the one referred to in footnote 1.

Table 5 is a list of the operators in May, 1941, then or formerly on the machines, arranged in order of their speed of production as averaged from three measures taken in October, 1939, April, 1940, and December, 1940. This is the criterion group. It is composed of all girls who were able to take the additional tests given in May, 1941, and of whom there were production records at one or more of these three times, and who had been on the machines for at least eight months on the dates production was measured.

Production scores follow the normal distribution pattern rather closely, considering the size of the sample.

Production Scores	Frequency
130–	2
120–129	4
110–119	15
100–109	14
– 99	4
	39
Mean	111.4

Each operator kept a record of the time required to post to ledger and statement cards and a count of the number of balances extended and the numbers of debits and credits posted. Two operators worked successively with the same items, one posting to the statement sheets and the other to the ledger sheets, so that all figures were verified. The raw data were transformed into production units through the use of a formula developed by The Burroughs Company. By the use of this formula the standard minutes for the number of operations performed can be calculated. When this figure is divided by the number of actual minutes required to perform the operation the production score is derived. An operator who works at the "standard" rate will have a production score of 100. The formula reads as follows:

$$\frac{\text{Balances} + 6\ (\text{Debits} + \text{Credits})}{30} = \text{"Standard" Minutes}$$

$$\frac{\text{Standard Minutes}}{\text{Actual Minutes}} = \text{"Production Score."}$$

Reliability of the Criterion

The reliability of each of the production trials was tested by determining the consistency between amounts of work done on the first and third days with the amounts done on the second and fourth days. The original and corrected coefficients are shown in the following table:

	Trial I Oct. 1939	Trial II Apr. 1940	Trial III Dec. 1940
Number	32	28	31
Range	94–124	94–153	95–126
r obt.	.88	.80	.96
r corr.	.93	.85	.98

The reliability of the final averages cannot be determined exactly since they are based upon data of varying reliability. However, it may be confidently regarded as satisfactory, although the consistency between the various trials is somewhat less than the consistency of each trial taken by itself. The inter-trial coefficients of correlation are shown in the following table:

	N	*r*	P.E.
Trial I with Trial II	26	.83	±.04
Trial I with Trial III	24	.79	±.05
Trial II with Trial III	24	.72	±.06

The Tests

Beginning in 1936, new bookkeepers were required to score 130 on both parts of the Minnesota Clerical Test and 32 on the 20-minute Otis S-A Test, Form B. This had little effect before 1941 because of small turnover of bookkeepers. In 1941 all bookkeepers were given 22 other tests. The correlations between the criterion and the scores on these tests are shown in Table 3.

All except three of the tests are well-known standard tests. Test 18, Number Writing, is essentially the subtest in the I.E.R. Clerical, modified by an arrangement of squares into which the numbers must be put in such a way that all numbers are in vertical alignment from right to left. Number 5, Name Finding, is a test designed to measure alphabetical selection or filing ability, devised by Mr. Paul K. Fryer. Number 10, Cook's Filing Test,[2] is a drawer containing 3″ × 5″ index cards, which are pierced with a rod in such a way that when a card is lifted at one end it can be tipped at 90 degrees without being removed from the drawer. The drawer contains about 800 cards arranged in alphabetical order. The subject is given a list of 100 of these names arranged in random order and the score is the number of correct cards turned up in 10 minutes. This test correlated .43 with the criterion but is not being used because there was a significant difference between test scores of experienced and inexperienced operators in favor of the experienced girls,

[2] Loaned by David W. Cook of Western Electric Co., Kearney, N. J.

Table 2

Comparison of Test Characteristics for Different Groups

Alpha Number Series	Range	Mean	Standard Deviation
a. 39 experienced bookkeepers tested	0–16	9.1	3.6
b. 57 bookkeepers tested (experienced and inexperienced)	0–16	9.7	3.3
c. 157 women who answered an advertisement, not experienced in bookkeeping	1–17	10.0	3.0
Fryer Name Finding			
a. 39 experienced bookkeepers tested	9–22	14.7	2.8
b. 57 bookkeepers tested (experienced and inexperienced)	9–22	14.7	2.8
c. 157 women who answered an advertisement, not experienced in bookkeeping	4–22	13.5	3.4
d. 118 women clerical applicants not experienced in bookkeeping	7–24	14.2	3.6
Minnesota Numbers			
a. 39 experienced bookkeepers tested	94–196	147.2	23.8
b. 241 experienced women clerical applicants	74–191	126.5	24.2
c. 229 inexperienced women clerical applicants	58–188	119.0	23.0
d. 1461 experienced and inexperienced women clerical applicants	60–199	128.5	25.5
Minnesota Names			
a. 36 experienced bookkeepers	64–186	138.8	22.5
b. 241 experienced women clerical applicants	66–190	132.1	25.5
c. 229 inexperienced women clerical applicants	52–192	124.1	26.1
d. 1472 experienced and inexperienced women clerical applicants	30–199	131.5	27.8

the critical ratio being 5.1. This test is nearly identical with the job and suggests that experience on the job gives practice in the test. The advantage which experienced operators have on this test is an example of the danger of constructing a test too much like the job. Unless such a test is separately standardized for inexperienced operators it will be of no value in predicting success, but will only discriminate between the better and poorer experienced operators.

It will be noted that the form of Army Alpha used was Guilford's Nebraska Revision.[3]

Reliability of the Tests

A study was made of the reliability of the tests that are used in Batteries I and II, with the following results:

[3] J. P. Guilford. A new revision of the Army Alpha Examination and a weighted scoring for three primary factors. *J. appl. Psychol.*, 1938, 22, 239–251.

Otis S-A, Form "B" (20 min.). In addition to the 39 cases in the bookkeeping machine-operator group, others were available who had been retested on Form "B." The total number of cases was 85 and the interval between tests was from eight months to six years. The correlation between first and second sets was .86.

Alpha Number Series. The split-half method produced an r of .79, corrected r being .88 with N of 57. Four months later a re-test was made, with the correlation between first and second scores of .86 and N of 48. Comparison of mean scores between two groups of bookkeepers, in one of which all girls had more than eight months' experience, and in the other of which all were inexperienced, showed a significant difference in favor of the inexperienced group. When two groups, experienced and inexperienced, were equated on Otis scores, and then compared, the difference between the mean scores on Number Series became insignificant. This is explained by the circumstance that the experienced group included most of the slower operators, many of whom made very low Otis and Alpha scores. They were employed before tests were used.

Fryer Name Finding. Split-half r was .71 for 68 cases and .83 corrected. Re-test r was .73 for 65 cases after four months. Difference between mean scores of experienced vs. inexperienced girls was not significant.

Minnesota Number Checking. Re-tests were available for 36 of the 39 bookkeeping machine operators and produced an r of .61 ± .06. Of these 36 cases, 14 showed an increase in test scores, 16 a decrease and 6 were unchanged (to within a 3 point difference). A group of 77 women clerks who were first tested at the time of employment were re-tested 8 to 16 months later. The re-test r was .69 ± .04. Another similar group of 59 women clerks, re-tested after 17 to 54 months, or an average of 38½ months, produced a re-test r of .56 ± .06.

Minnesota Name Checking. Comparison of test and re-test scores for 36 machine bookkeepers gave a correlation of .75 ± .05.

The group of 77 new women employees produced a re-test r on the name test of .62 ± .05. The group of 59 produced an r of .81 ± .03.

The statistics of all three groups on number and name tests are as follows:

	36 bookkeepers		77 women clerks		59 women clerks	
	Numbers	Names	Numbers	Names	Numbers	Names
r_{12}	.61±.06	.75±.05	.69±.04	.62±.05	.56±.06	.81±.03
M_1	146.9	138.8	137.1	142.3	146.3	142.8
σ_1	22.2	22.5	19.3	16.5	16.1	25.3
Range$_1$	94–192	64–186	96–196	108–192	80–198	64–194
M_2	145.1	133.9	151.1	155.8	152.2	144.3
σ_2	22.9	25.1	20.9	18.6	18.1	28.7
Range$_2$	92–194	62–170	98–196	113–194	92–194	62–194

Administering the Tests

The time required to give the complete battery of tests was about four hours and it was a problem to take the bookkeepers away from their work for this long. Finally, arrangements were made to have the girls tested during their summer Saturday holidays and they were paid for their time at the rate of $1.00 per hour. This solved the problem of finding the time for testing and produced very good cooperation from the girls.

Results

Table 3 shows the correlations between the criterion and all tests. It will be noted that all the higher coefficients of correlation are of tests of verbal or numerical material, or tests with these two kinds of material mixed.

Table 3

Correlations for 39 Bookkeepers

Test	Correlation with Production	Probable Error of Correlation
1. Otis S.A. 20-min.	+.56	±.07
2. Alpha Number Series	+.56	±.07
3. Minnesota Numbers	+.51	±.08
4. Alpha Total	+.51	±.08
5. Fryer Name Finding	+.48	±.08
6. Alpha Same—Opposites	+.47	±.08
7. Minnesota Names	+.47	±.08
8. Alpha Verbal	+.47	±.08
9. Alpha Numerical	+.44	±.09
10. Cook's Filing	+.43	±.09
11. Alpha Relationships	+.43	±.09
12. Alpha Analogies	+.42	±.09
13. Alpha Information	+.40	±.09
14. Alpha Sentences	+.40	±.09
15. Alpha Arithmetic	+.37	±.09
16. Alpha Directions	+.32	±.10
17. Worker Analysis Bi-Manual Peg Board	+.24	±.10
18. Fryer Number Writing	+.22	±.10
19. Alpha Judgment	+.20	±.10
20. O'Connor Pinboard	−.09	±.11
21. Ziegler Rate of Manipulation, Left	−.06	±.11
22. Worker Analysis Washer—Assembled	−.05	±.11
23. Ziegler Rate of Manipulation, Turning	−.04	±.11
24. Ziegler Rate of Manipulation, Right	−.03	±.11
25. Worker Analysis Washer—Unassembled	−.01	±.11
Years of Experience	+.05	±.11

Six of the tests were of hand, arm and finger dexterity. The operation analysis of the job revealed a good many such movements and it appeared likely that one of these tests would show considerable relationship with the criterion. The fact that none did suggests that the mental abilities required are so overwhelmingly important that the dexterities can be ignored. Marion A. Bills, in correspondence with the author, reports similar findings.

Intercorrelations were calculated for all tests. The battery that had been in use for several years, namely the Otis and the two Minnesota tests, produced a multiple R of $+.65 \pm .06$. Good results were also obtained with a battery consisting of Alpha Number Series, Fryer Name Finding and Minnesota Numbers. This gave an R of $+.70 \pm .05$. Table 4 shows the intercorrelations of the tests that went into the Wherry-Doolittle multiple correlation formula, and gives the range, standard deviation and mean of the five tests used in the two multiple batteries just mentioned. These two batteries are now being used in the selection of new bookkeepers.

Multiple correlations were calculated for several other combinations. Battery III was the result of the use of the Wherry-Doolittle method into which calculations went the scores of all tests shown in Table 4.

Table 4

Intercorrelation for 39 Bookeepers

	Otis	Alpha Arithmetic	Alpha Same-Opposite	Alpha Sentences	Alpha Number Series	Alpha Analogies	Fryer Name Finding	Minnesota Numbers	Minnesota Names
Production	.56	.37	.47	.40	.56	.42	.48	.51	.47
Otis		.54	.71	.72	.68	.78	.55	.36	.41
Alpha Arithmetic			.53	.42	.68	.38	.41	.22	.47
Alpha Same-Opposite				.71	.59	.54	.52	.27	.45
Alpha Sentences					.55	.61	.44	.17	.24
Alpha Number Series						.67	.35	.34	.56
Alpha Analogies							.34	.20	.38
Fryer Name Finding								.23	.38
Minnesota Numbers									.71
Minnesota Names									
Range	17–59				0–16		9–22	94–196	64–186
Standard Deviation	10.3				3.6		2.8	23.8	24.5
Mean	32.5				9.1		14.7	147.2	138.7
P. E. mean	2.6				0.9		1.0	10.1	8.6
Experience:									
Range	9 months to 19 years								
Mean	9.2 years								

All other batteries were calculated by the Doolittle method.

Battery	*R*
I. Alpha Number Series, Fryer Name Finding, Minnesota Numbers	.70±.05
II. Otis 20-min., Form B, Minnesota Numbers, Minnesota Names	.65±.06
III. Otis 20-min., Form B, Minnesota Numbers, Alpha Number Series, Fryer Name Finding	.71±.05
IV. Otis 20-min., Form B, Minnesota Names	.62±.07
V. Minnesota Names, Alpha Analogies, Alpha Sentences	.56±.07
VI. Otis 20-min., Form B, Minnesota Names, Alpha Sentences	.62±.07
VII. Otis 20-min., Form B, Minnesota Names, Alpha Arithmetic	.62±.07
VIII. Otis 20-min., Form B, Alpha (total score) Minnesota Names, Minnesota Numbers, Fryer Name Finding	.68±.06

A practical expression of the efficiency of Battery I may be seen by reference to Table 5, which lists the criterion, or actual production records, in contrast with the predicted production resulting from the use of Batteries I and II. Battery I predicts success for 19 of 21 operators whose production record is 110 or better, a percentage of 91. Battery II predicts 81 per cent of the successful operators. Both batteries predicted success for 5 of the poorer operators, a "miss" of 28 per cent. Battery III, resulting from the use of the Wherry-Doolittle method, was successful in predicting 85 per cent of the successes and missed on 28 per cent of the failures.

One critic of this paper has suggested that the correlations that were obtained would have been higher if the range of performance of the group had not been somewhat small, due, no doubt, to a homogeneity of the group resulting from long service on the job. The correlations obtained are probably "lower than . . . if an unselected group were hired and given equal chances to succeed or fail."

Another critic refers to another experiment in which a test gave a positive correlation with success when applied to those who were already on the job, but subsequently gave none when applied to newly hired persons. He therefore suggests caution in investigating differences in scores between our experienced group and newly hired inexperienced persons. Fortunately, such comparisons are available and, except for tests which were discarded, no significant differences were discovered that seem to relate to our use of the tests.

Table 5

Comparison of Actual and Predicted Production

Operator Number	Actual Production Record	Production Predicted by Battery I (Number Series / Minnesota Numbers / Name Finding)	Production Predicted by Battery II (Otis / Minnesota Numbers / Minnesota Names)
1	140	131	129
2	130	122	122
3	129	118	121
4	124	117	114
5	123	112	108
6	120	128	130
7	119	111	113
8	118	114	121
9	118	122	120
10	117	108	104
11	117	121	117
12	115	97	99
13	115	117	119
14	114	119	126
15	113	110	101
16	113	119	122
17	113	114	119
18	113	125	116
19	112	126	117
20	110	112	123
21	110	113	116
22	108	108	109
23	108	110	114
24	108	112	108
25	106	108	100
26	106	102	103
27	106	102	101
28	106	106	102
29	105	107	114
30	104	105	100
31	104	111	109
32	104	119	118
33	103	105	104
34	103	100	103
35	103	104	99
36	98	110	113
37	98	89	94
38	96	103	100
39	94	87	96
Mean	111.4		

Correlations were calculated with the Powers tabulating machine. Despite the lack of previous experience in running correlations with this equipment, it seemed advisable to give it a try in the expectation that the work of calculating intercorrelations for 25 tests would be less than if scattergrams or calculating machines were used. It transpired that much more labor was involved than was anticipated, the Powers equipment not being as well adapted to the work as is the Hollerith machine. Calculations of r's were from ungrouped scores.

The prediction formula for Battery I, corrected for dispersion, is

$$\bar{X}_0 = 1.34 \times \text{No. Series} + .19 \times \text{Minn. Nos.} + 1.27 \times \text{Name Finding} + 52.43$$

and for Battery II is

$$\bar{X}_0 = .59 \times \text{Otis} + .19 \times \text{Minn. Nos.} + .05 \times \text{Minn. Names} + 57.84.$$

Additional Data

A steady improvement in the average production of bookkeepers has taken place since tests were first used. The following table shows the average production record of all operators on whom records were available on the dates shown. The lower number of operators at the later dates is due to the presence of new and unseasoned workers.

Date	N	Average Production
October 1937	43	105.0
November 1939	40	108.7
April 1940	30	109.7
December 1940	32	110.2
December 1941	26	110.9

Summary

The problem was to find tests from whose scores the future success or failure of bookkeeper job applicants could be predicted. A reliable criterion was obtained and 25 tests were administered to bookkeepers then on the job. By the use of multiple correlation several efficient test batteries were identified, the best ones of which predicted 91 per cent of the better operators and 72 per cent of the poorer ones. Two of these batteries have been used for nearly five years with excellent results.

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A Method of Constructing Learning Curves for a Motor Skill Involving Total Body Speed and Accuracy

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The purpose underlying this investigation was the determination of a method of constructing learning curves for a motor skill involving speed and accuracy of a total body movement.

Procedure in Organizing and Collecting the Data

The subjects used in this investigation consisted of a group of eighty-seven male subjects selected at random from the student population of the City College of New York. Where medical records indicated physical disability of any type, the individual in question was excluded from participating in the experiment.

The group was heterogeneous from the point of view of socio-economic status, nationality, and attitudes and interests in motor skills, but was relatively homogeneous with respect to the number of years of school experience and intelligence.

Selection of the Motor Skill. The fencing lunge was selected as the motor skill to be subjected to investigation for the following reasons: (1) it represents a bodily movement in which comparatively few people have had any previous experience; (2) improvement in the skill may be measured objectively by the use of precision instruments, and (3) the skill offers an excellent opportunity to observe the development of new muscular patterns and coordinations. Furthermore the complete action of the skill contains the "four properties of action systems which stand at the root of our habits, skills and posture," [1] namely, strength, quickness or speed, coordination and accuracy.[2]

Speed-Accuracy Apparatus. A device originally designed by E. R. Elbel,[3] but modified for the present investigation, was employed in measuring the accuracy and speed of the fencing lunge. Elbel's original design consisted of two main parts, a target by means of which accuracy was measured and a chronoscope which was used for recording time

[1] C. R. Griffiths, *Psychology applied to teaching and learning*, p. 250.

[2] *Ibid.*, p. 250.

[3] E. R. Elbel, A study of response time before and after strenuous exercise. *Res. Quart. Amer. phys. Educ. Ass.*, 1940, 11, 86–95.

intervals. A preliminary tryout of this apparatus revealed certain functional and structural inadequacies. For example, the accuracy score values, while adequate for one administration of the test, did not permit a large enough variation among accuracy scores of individuals. This point was important because as individuals learned, the development of a skewed curve would bring all high scores into a coarse collection interval and obscure differentiation of abilities. A second inadequacy was found in the use of 110 volts for wiring the foil. A current of this voltage is

FIG. 1. The metal target and its backing board.

dangerous and is definitely a source of shock despite all precautionary measures. Accordingly the apparatus was modified but the basic design maintained throughout.

The apparatus as utilized in this experiment consists of three major parts: the target, the clock, and the control cabinet. The target was constructed by using nine galvanized tin circles, ranging in size from ¾ inch in diameter to 13½ inches in diameter. Each respective larger circle was ¾ of an inch greater in radius than the preceding smaller circle. (See Figure 1.) A wire was soldered to each circle and passed through

$\frac{3}{16}$ inch holes that had been drilled previously through the entire set of circles. Furthermore, each circle was insulated by placing cardboard circles between them. The materials were next fastened to a wooden backing board by a bolt that passed not only through the metal target but also the backing board. (See Figure 2.) This was attached to the apparatus framework by means of two strap iron hinges. The electrical wires were then numbered to correspond to the score values of the circles, the smallest circle representing a score of 9, and proceeding outward to scores of 8, 7, 6, 5, 4, 3, 2, and 1. Nine long extension wires were attached to these and wired to bulbs in the control cabinet. Thus when

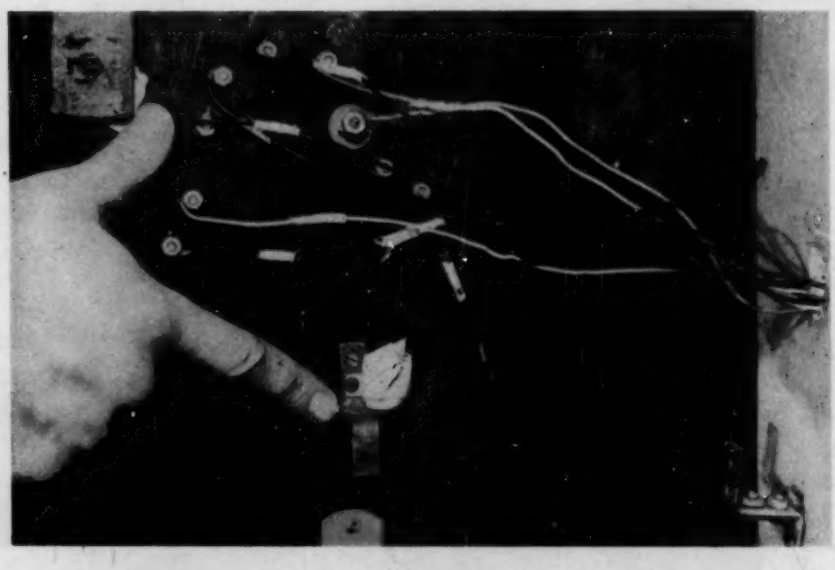

FIG. 2. Wiring of the circles and attachment to the backing board.

the electrically wired foil struck any one of the circles, the score value immediately flashed.

Electrical Design of the Apparatus. The device was so wired that the moment the operator pulled the starting switch, a signal light flashed and the electric clock began to operate.[4] When the subject saw the stimulus he lunged toward the target. The impact of the foil not only flashed the accuracy of the lunge but broke the electrical circuit operating the clock, thus indicating the speed with which the lunge was performed.

Two electrical circuits were housed within the control cabinet, one circuit controlling the accuracy scores, the other controlling the clock.

[4] The electric clock is manufactured by the Standard Electric Time Company of Massachusetts. The face of the clock is calibrated to indicate 1/1000 of a second.

A transformer was used to reduce the 110 volt circuit to 6–8 volts and the foil was wired to this circuit by placing a small tip-jack in the rear of the control cabinet. By using an extension cord the foil could be moved to any distance. When the foil touched any area of the target, the circuit was completed and one of the bulbs flashed the score.

The speed circuit drew current from two sources, A.C. and D.C., since the motor of the clock operated upon 110 volt A.C. current while the clutch which operated the second hand, worked on 110 volt D.C. current. Since the room in which the experiment was conducted had only D.C. current a converter was used in order to have available both

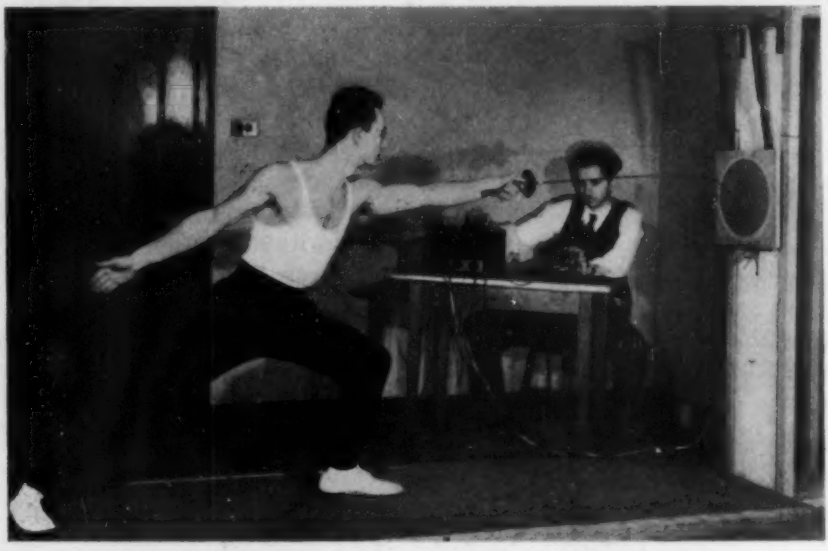

FIG. 3. Position of the subject, the operator, and the apparatus.

types of voltages. The control cabinet drew only 110 volt D.C. current so that breaking the circuit would leave the motor running while the second hand stopped. A complete representation of the apparatus is illustrated in Figure 3.

Reliability of the Apparatus. The reliability of the instrument was determined by means of the re-test method. A group of 116 subjects was selected from the summer session student body during the summer session of 1941. For purposes of expediency and accuracy the group was divided into four groups of twenty-nine in each group. The purpose of this preliminary test was explained in detail with emphasis placed upon the need for conscientious cooperation. Two days were used in determining the length of the lunge of each individual, two days were

required for the first set of data while an additional two days were used for the collection of data for the second trial. A period of one week elapsed between the administration of the first and second tests. Using the average of ten trials, a reliability coefficient of 0.937 was obtained for speed with a reliability of 0.921 for accuracy.

Administration of the Speed-Accuracy Test. The experimental group met twice a week for twelve weeks with each weekly period of forty-five minutes duration. These sessions were used for purposes of training and instruction. Individual appointments were arranged so that each subject was examined once a week for the total period of twelve weeks. The length of the lunge was determined for each individual by demonstrating the correct position for the lunge and noting the distance along a ruler placed on the side of the fencing strip. A movable foot cleat was used to mark off the correct distance each time the subject appeared for the weekly test.

Collection of Data. Five or six preliminary lunges were utilized as a warming up period and the subject was then asked to start the trials. The subject was told not to look at the stimulus unit, but at the target, since the light was strong enough to be seen without staring directly at it. As soon as this flashed the subject lunged toward the target as accurately and as quickly as he could. The interval between the stimulus was varied in order to avoid mechanization of the lunge. Each trial was recorded upon forms specifically prepared for recording these data. Using the average of the ten trials in speed and accuracy, these data were transferred to a large posting sheet where it could be seen by all individuals participating in the experiment.

Treatment and Analysis of Data

It is important to emphasize that the present investigation was directed toward a description of the differences involved in a learning process, rather than attempting to account for factors and reasons underlying learning *per se*. Therefore the basic problem consisted of analyzing the data obtained over a period of twelve weeks in order to supply an answer to the theoretical question, "What does the shape of the learning curve look like?" Two approaches were used; the first approach assumed that there was some generalized law in operation tending to influence the data in such a way as to produce a curve typical of the learning function. In this case it was a question of selecting a second degree parabola, a log curve, or any one of a number of curves commonly encountered in learning experiments. The second approach was based upon a preliminary examination of the data with the express purpose of proceeding upon the information divulged from such statistical analysis.

Since the concept of individual differences was of paramount importance, three elements were selected by means of which these differences might be distinguished, namely, initial status, rate of learning, and maximum learning at the end of the experimental period. Several mathematical techniques were capable of producing such information but it appeared important to select a technique that was related logically to the data at hand. Hence, two methods were selected, the Courtis Isochronic technique [5] and the freehand method. The Courtis technique was selected because it uses the Gompertz equation and curve as the function underlying growth. If learning was accepted as a type of growth then there was a very logical basis for the choice of this particular technique. This reasoning is corroborated by Ezekial who indicates that "When there is some logical basis for the selection of a particular equation, the equation and the corresponding curve may provide a definite logical measurement of the nature of the relationship." [6] As an alternative the freehand method was also investigated in the event that the Courtis method was found to be inadequate. This particular point is again confirmed by Ezekial: ". . . a curve fitted freehand by graphic methods, and, conforming to logical limitations on its shape, may be even more valuable as a description of the facts of the relationship than a definite equation and corresponding curve selected empirically." [7]

Of the two methods discussed above, the freehand method was chosen for reasons presented in the following section.

Technique Employed in this Study. Originally the intention was to combine the speed and accuracy scores into one index number that would represent an individual's performance at any one testing period. This was to be accomplished by dividing accuracy by speed. However, after some deliberation this method was not employed. It was felt that an arbitrary combination of this nature might be open to sound criticism. Therefore the speed and accuracy scores were treated independently.

Means and sigmas were computed for both speed and accuracy scores for each of the twelve week testing periods and Pearson product-moment coefficients were computed between successive weekly periods; that is, the correlation between the first and second week was determined, then the correlation between the second and third weeks, etc. The data obtained for the accuracy scores are contained in Table 1.

The means were used to determine the progress of learning for the entire group; the measures of variability yielded an analysis of the relative weight ascribed for portions of the learning curves and the successive

[5] S. A. Courtis. *The measurement of growth.*

[6] M. Ezekial. *Methods of correlation analysis*, p. 127.

[7] *Ibid.*, p. 127.

Table 1

Measures of Central Tendency, Variability and Successive Correlations between Weekly Periods for Accuracy Scores

Period	Mean	Sigma	r
1st	49.63	12.20	
2nd	57.97	10.27	.658
3rd	61.99	8.13	.583
4th	65.09	6.91	.624
5th	67.25	6.46	.603
6th	69.00	5.50	.761
7th	71.38	4.47	.726
8th	72.62	4.96	.829
9th	72.90	4.43	.899
10th	73.23	4.69	.928
11th	73.78	4.83	.949
12th	75.07	4.68	.936

weekly correlations were computed in order to ascertain the degree to which the group tended to level off. It was reasoned that as individuals reached a peak of learning and development, the degree of association existing among the scores made during the final weeks would tend to become high.

The values of sigma and r obtained for the tenth, eleventh, and twelfth weeks were considered extremely significant. During this specific time interval, the sigmas are approximately equal as are the correlation coefficients. This apparently confirmed the use of the above mentioned computations and indicated that some type of maximum development had occurred. Because of the slight numerical differences existing among the sigmas and coefficients the question then arose as to whether these differences were statistically significant or had occurred because of chance fluctuations. While the use of Critical Ratio could answer the question of significant differences, it did not consider changes in individual status. Hence some expression of the relationship between sigmas and correlation coefficients was needed. The following principle appeared to offer just such solution. *Individual differences in learning cannot be measured when the correlation coefficients of successive time intervals are equal and when the sigmas of the same successive time intervals are also equal.* While such statement presumably suggested a reason for the similarity of numerical values among the sigmas and r's for the accuracy scores, rigorous statistical proof was lacking. Such proof was developed by assuming that the correlation between the differences of successive correlations would be equal to zero only if chance errors were involved. Since chance errors are uncorrelated a numerical value of zero would indicate

the absence of any other experimental factor tending to make for such slight differences.[8] On the basis of this evidence it was then possible to combine the scores of the last three weeks into one score that represented maximum learning. Thus, one of the factors essential in describing individual differences was obtained.

The sigmas of the first two weeks were large relative to succeeding ones. This constituted evidence that they failed to represent reliable initial points for learning rates, though they *may* be used as indices of initial ability. It is pointed out that no individual in the experimental group had had any previous experience in the fencing lunge. Therefore, theoretically the sigmas should have been somewhat the same for the first two weeks and thereafter should have become larger as individual differences manifested themselves. However the obtained large variance at the initial stage includes factors of pre-training and previous experience in skills involving similar bodily movements, and hence unduly affects the rate of learning of those who have lower starting points on the learning curve. It was for this reason that the Courtis technique was not found to be completely adequate. In many cases when this method was used, the percentages of development at the very beginning of the experiment were found to be fairly high; in some cases as high as forty-five per cent. This fact tended to obliterate the bottom portion of the Gompertz curve and resulted in a segment of the curve. Furthermore, curves of individuals starting fairly low, continuing with a large gain the subsequent week, and proceeding thereafter at a slow rate of learning, were overweighted because of the necessity of fitting a line to the data. Apparently then, information regarding the rate of learning based on such overweighting would tend to obscure much of the actual evidence. Hence the scores of the first two weeks were combined to represent the initial status, but were not included in the rate of learning calculations. In this way, the second independent factor, initial status, was obtained. The scores within the period extending from the third to the ninth week were then used to compute the third factor necessary for distinguishing individual differences, namely, rate of learning.

The speed scores were examined in the same fashion and in this instance the independent treatment of speed and accuracy was more than justified. The speed scores show some startling facts that would not have been brought to light had speed been combined with accuracy. The results contained in Table 2 show that the means increase by week and also demonstrate a total group improvement. There is a rapid acceleration for the first four weeks followed by a decrease in acceleration

[8] A complete mathematical development of this proof is contained in a paper, as yet unpublished, written by Dr. Raymond Franzen and the writer.

Table 2

Measures of Central Tendency, Variability and Successive Correlations between Weekly Periods for Speed Scores *

Period	Mean	Sigma	r
1st	0.760	.058	
2nd	0.707	.064	.677
3rd	0.664	.060	.648
4th	0.644	.057	.834
5th	0.627	.056	.872
6th	0.613	.054	.874
7th	0.598	.055	.875
8th	0.588	.049	.908
9th	0.586	.050	.930
10th	0.578	.049	.965
11th	0.573	.048	.939
12th	0.561	.049	.961

* Time measured in 1/1000 of a second.

up to the sixth week, with scores leveling off thereafter. The characteristic end-spurt appears in this instance as well as in the accuracy data. One bit of interesting information that is not clearly evident is the very small time interval within which improvement manifested itself. The mean score for the sixth week was 0.613 of a second, while the mean score for the twelfth week was 0.561 of a second, a difference of only 0.052. Therefore the group appeared to be functioning closely to its maximum speed efficiency after the sixth week of the experiment. Because of similarities in the sigmas, they could not be used as reliable indices for learning rates. Two factors might have accounted for such similarities; the refined unit in which speed was measured, or the fact that subjects who were slow at the beginning of the experiment remained slow for the duration of the experiment and similarly, subjects who were initially fast remained fast. As in the case of the accuracy data, there is a decided shifting around in positions during the first three weeks after which the high correlations signify a status quo. This is shown by the size of the correlation coefficients which range in size from .834 at the end of the fourth week to .961 at the end of the twelfth week. Such numerically high coefficients could not have been obtained had the reverse been true. Therefore the measurement of individual differences on the basis of speed scores could be accomplished only by three broad time intervals with the scores achieved during the first three weeks serving as initial scores, the scores for the fourth, fifth, sixth, and seventh weeks serving as rates of learning and the remainder being used for maximum end points.

Application of the Method of Least Squares. On the basis of the above

statistical analysis the method of least squares was used to construct learning curves. The principle underlying the use of this technique is one wherein "the curve of a given type which best fits a given set of points is one in which the constants of the equation are so chosen as to make the sum of the squares of the errors a minimum." [9] Since the initial starting points and the terminal end points were already available this method of least squares yielded rates of learning and thus produced the third item essential for describing individual differences in learning.

Conclusion

1. In experiments involving speed and accuracy of total body movements the construction of learning curves may be best accomplished by analyzing the data from three points of view, initial status, rate of learning, and maximum end points.

2. Curve fitting techniques should be examined and analyzed to see whether the function underlying any one curve adequately fits the data at hand.

3. Skills involving speed and accuracy of total body movement do not necessarily follow the normal curve, the ogive, the autocatalytic curve, or the Gompertz equation, since factors of pre-training and conditioning negate the possibility of a zero origin and thus exclude the lower portion of these curves.

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[9] C. C. Peters and W. R. Van Voorhis. *Statistical procedures and their mathematical bases*, p. 426.

Studies in International Morse Code
2. Errors Made in Code Reception

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Daily records of the progress of fifty Columbia College students in learning to recognize the thirty-six basic signals of International Morse Code have been examined for the purpose of determining (*a*) the relative difficulty of the different signals and (*b*) the most common confusions of signals responsible for this difficulty.

A detailed description of the training method employed has been given in an earlier paper.[1] Audio-oscillator signals were presented to the students by a trained radio operator. Each signal was transmitted with a standard telegraph key at a speed, for the individual signal, of eighteen to twenty words per minute. Approximately three seconds after the termination of each signal, it was identified orally by the operator. This identification, in the case of the letters of the alphabet, was made by announcing the appropriate Signal Corps "phonetic equivalent" of the letter ("Able" for "A," "Baker" for "B," etc.). The digits were identified by their usual names. About one second after each identification, the next signal of a series was presented. After this signal was named, the next one was presented, and so on, until a practice run of one hundred signals was completed. All thirty-six signals were presented in random order during each run, and the attempt was made to give each signal equal representation throughout the entire series of runs up to the point of mastery. The criterion of mastery chosen was three successive runs in which the student's responses were at least ninety-five per cent correct. Three or four runs were usually given during each fifty-minute practice period, and these periods came at the same hour daily, five days a week.

A student's progress, under this system of training, was indicated by his increased ability to respond to each stimulus-signal with the correct letter or digit *prior* to the instructor's identification. Each character was printed by the student in prescribed (military) fashion, and suitable practice sheets made it possible for the student, immediately following each announcement by the instructor, to substitute for an erroneous or omitted character the one he should have written. These practice sheets

[1] F. S. Keller. Studies in International Morse Code: 1. A new method of teaching code reception. *J. appl. Psychol.*, 1943, 27, 407–415.

thus furnished the data for the error tabulation shown below. Only the first run of each hour prior to mastery was examined for errors and omissions.

All students were inexperienced in code, and before beginning their training they listened to but one identification of each signal. The average number of fifty-minute periods required for the entire class (67 students) to reach the point of mastery was twelve (range, 4–31), and these figures hold approximately for the fifty students whose records were selected for error tabulation.

Table 1 gives the total number of errors and omissions made by all fifty students in the records examined. The characters are arranged in

Table 1

The Rank Order of Difficulty for 36 Morse Code Characters

Character	Errors and Omissions	Character	Errors and Omissions
P	900	1	481
W	854	R	454
J	767	7	438
F	714	4	408
Y	663	8	378
G	657	H	363
Q	629	9	329
L	611	5	311
Z	606	V	302
3	565	S	212
U	549	N	210
B	545	O	199
2	542	M	190
C	539	A	183
D	537	I	168
X	523	T	129
6	514	Ø	112
K	502	E	51

the order of "difficulty," from greater to less. Thus, the signals for "P," "W," and "J" were most often the source of omitted or incorrect responses, whereas the signals for "T," "Ø" (zero), and "E" were most often recognized correctly.

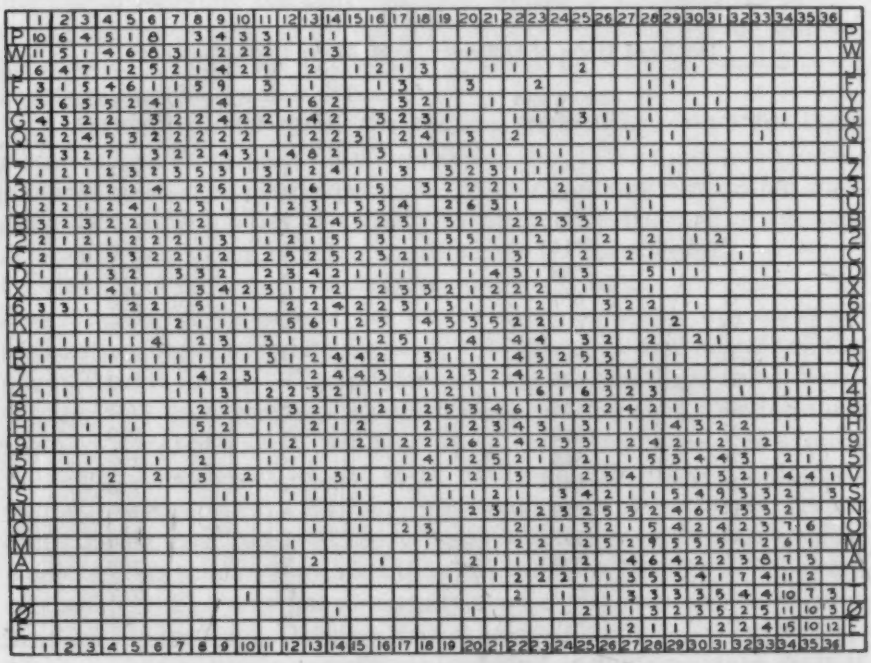
This rank order of difficulty does not, however, hold for each individual student, a fact that is clearly brought out in Table 2 where is shown the number of times each signal was found to be first, second, third, etc., in difficulty. The ranks are indicated at the top of each column of this table, and the character to be ranked is shown at the end of each row. The entry in each box represents the number of students

who found a given character of greater or less difficulty. Thus, the letter "P" ranked first in difficulty for ten students, second in difficulty for six students, third for four, etc. The general trend of difficulty appears in the gradual shift of box entries from left to right as one passes from the top to the bottom of the table, but it is clear that no single rank order holds for all individuals.

Table 2

Distribution of Rank Order of Difficulty

The ranks are indicated at the top and bottom of each column, and the character to be ranked is shown at the end of each row. The entry in each box represents the number of students who found a given character of greater or less difficulty. (See text.)



If a larger number of records were examined, or alternative methods of treating the data were employed, a slightly different and possibly more significant rank order of difficulty might be obtained. Moreover, the order obtained may not be independent of the method of training: the "whole" method, used in the present study, need not give the same ranking as the various "part" methods that could be used. The present approximation is, however, sufficient for the purposes of this report.

Since "difficulty" is here defined in terms of both erroneous and omitted responses, it is of some interest to note the correlation existing between these two indices, as well as the relation of each index to the

total difficulty rank. Between errors and omissions there is a rank correlation of +.84 (P.E. = ±.03); between errors and difficulty there is a rank correlation of +.91 (P.E. = ±.02); and between omissions and difficulty the rank correlation is +.98 (P.E. = ±.005). It appears from the first correlation that errors and omissions measure essentially the same thing. One may also conclude that omissions contribute somewhat more to the difficulty than do erroneous responses. Although the two latter correlations are obviously spurious, since the difficulty ranking is a composite of both errors and omissions, they may be regarded as equally spurious, hence comparable.

In this connection may be cited a study by Spragg [2] who used the present method in teaching code to 19 students at Queens College, and also determined a difficulty rank order. It is not easy to compare Spragg's findings with those of the present study, since he used only the alphabet signals, but a rank correlation of +.91 (P.E. = ±.02) exists between his rank order and the one obtained when the numerals of Table 1 are omitted.

Spragg argues for two distinct "families" of letters with respect to difficulty. He found, for his "difficult" group, 50.0 per cent of the "errors" to be those due to erroneous responses, whereas, for the "easier" group, 63.0 per cent were attributable to this source. This difference he found to be significant. In other words, the indication is that the more difficult characters are more often omitted, whereas the easier signals evoke more erroneous responses. This finding may have some bearing upon the question as to why the rank correlation between errors and omissions in the present study was not higher than +.84.

The difficulty of a given character, however, is primarily due to the confusion of one signal with one or more than one other signal, by virtue of properties which they possess in common as discriminative stimuli; and it is at present of more practical importance to know the causes of the rank order than to know the rank order itself. Tables 3 and 4 provide relevant data. In Table 3 is given, in the box entries, the number of times that a particular signal was confused with other signals. Confusions less than five in number are not recorded in the table. The characters at the top and bottom of the columns refer to the nature of the incorrect responses made, and the characters at each end of the rows indicate the signal actually presented. It will be seen, for example, that the signal for the letter "P" gave rise, in seventy-seven cases, to the written response "J"; in fifty-six cases, to the response "F"; in fifty-two cases, to "L"; and so on.

Table 4 shows, in more abbreviated form, the most common confu-

[2] S. D. S. Spragg. The Relative Difficulty of Morse Code Alphabet Characters Learned by the Whole Method. *J. exper. Psychol.*, 1943, 33, 108–114.

Table 3

Distribution of Incorrect Responses

The characters at the top and bottom of the columns refer to the nature of the incorrect responses made, and the characters at each end of the rows indicate the signal actually presented. (See text.)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	1	2	3	4	5	6	7	8	9	Ø	
P		13	29	7		56	5			77	9	52					21				5		7	20	9	14	22	9	9				11				P
W	7	7	16	27		10	46		11	13	29	11	23		10			88	5		73	6				5										W
J		26	8	5		9	7	7			12	29			8	21	10				9	7	15	5	10	18	94	46	19			5	6		7		J
F		9	21				8	10			10	59				38	31	10				26		13	13	11			13								F
Y		10	86	8		9				6	13	25				11	41						11	53		8	5									Y
G		14	8	29		9		6		11	15	11		8	23	6	7	32	5		18	7	42			7										G
Q		10	14	6		21				7	11	41				16					5	5		14	44	68	8					5				Q
L		8	32	7		25	6		5	5	10		6			37	18	8					6	11	9	49										L
Z		13	9	9		13	19					27		6		8	49	5			7		9	8	9			8	5			6	28	8			Z
3						15	5			5		5					9						13	5		8	5	22	36		50	7		11	20	10		3
U	10	8		26		8	14	7			9	9		6	6			9	43			38	42														U
B				20		5	6	8		13	8	6		6		6						12		26	8		7					87	9				B
2								5		9		5					7								5	5	27		143	10	6		22	19	8	6	2
C		8		5		11	5				9	12				21	22	5						37	93												C
D	6	43	10			9	21			11	38	12		10				13			19		28									5					D
X		62	11			19				8	18	7				30	25					9	5		22	13							14				X
6		134	6							6														6			47	8	6	22	12		9		15		6
K		8	13	41			10					8		5	6	5		56			5		17	14	12												K
I										35						5												100	12	19	5	13	19	5	24	21	I
R	7	12	13	18		9	23		8		40	19		5		7					12		22														R
7		5								5							6							5	5	35	13	36	14			20		18	7		7
4								8														75					16		15		53	12	5		29	7	4
8											5						6							5	13	6	12	28	10	6	9	44		18			8
H									9						13				138		5	19							10	49							H
9								7				6															11		31	24			29		59	9
5								113											27								8		20						21	5
V								17				5							7		15		6				5		42								V
S								30	24				5		21						6	5															S
N	53	6		8					12				11								6																N
O								12	5				13						26		6								5								O
M	21							7	21			6		10	7						8																M
A					14			5	14				8	20							9																A
I	19				7			6					17	8					22																		I
H					49								6																								H
Ø															6														6	32				8		Ø
E																					10																E
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	1	2	3	4	5	6	7	8	9	Ø	

sions of Table 3. The frequency of each erroneous response is shown parenthetically in order that the relative importance of the errors may be readily perceived. From "P" to "5," inclusive, only those confusions are listed which appeared twenty or more times in the records; from "V" to "E" confusions are listed if they appeared as many as ten times.

A glance at either of these tables will make it clear that certain characters, such as "K," "8," and "H," are difficult almost exclusively because of their confusion with only one or two others of the entire group. In contrast with this, such characters as "P," "W," and "J" derive their difficulty from confusion with only a larger number of other characters.

Table 4

A List of the Most Common Incorrect Responses to Morse Code Signals

P—J(77), F(56), L(52), C(29), 1(22), Q(21), X(20).	K—R(56), D(41).
W—R(88), U(73), G(46), K(29), D(27), M(23).	1—2(100), J(35), 9(24), Ø(21).
J—1(94), 2(46), L(29), B(26), P(21).	R—K(40), G(23), W(22).
F—L(59), P(38), Q(31), V(26), C(21).	7—2(36), Z(35), 6(20).
Y—C(86), X(53), Q(41), L(25).	4—V(75), 5(53), 9(29).
G—W(42), R(32), D(29), O(23).	8—7(44), 3(28).
Q—Z(68), Y(44), L(41), F(21).	H—S(138), 5(49).
L—Z(49), P(37), C(32), F(25).	9—Ø(59), 4(31), 8(29), 5(24).
Z—Q(49), 7(28), L(27).	5—H(113), S(27), Ø(21), 4(20).
3—4(50), 2(36), 1(22), 8(20).	V—4(42), H(17), U(15).
U—S(43), W(42), V(38), D(26).	S—H(30), I(24), O(21).
B—6(87), X(26), D(20).	N—A(53), I(12), M(11).
2—3(143), 1(27), 7(22).	O—S(26), M(13), H(12).
C—Y(93), X(37), Q(22), P(21).	M—A(21), I(21), N(10).
D—B(43), K(38), W(26), G(21).	A—N(20), E(14), I(14).
X—B(62), P(30), Q(25), Y(22).	I—S(22), M(17).
6—B(134), 1(47), 4(22).	T—E(49).
	Ø—5(32).
	E—T(10).

Moreover, the most difficult characters, in terms of rank order, need not be characters which are readily confused with *each other*. Although "R" and "K" have nearly the same ranking and are often mistaken for one another, "P" and "W," which are practically equal in difficulty, are hardly confused at all.

Various applications of the data presented in these tables will suggest themselves to the reader who is interested in the problem of radio-operator training and selection. It should now be possible, for example, to arrange *groups* of characters which will present any difficulty level desired in training beginners in code; special series of characters may be constructed to point up common pitfalls in learning; and the representation of easy and difficult characters may be weighted in order to avoid unprofitable expenditure of training time. The suggestion also presents itself that certain striking and persistent confusions of characters, such as that of "5" with "H" and "H" with "S," may have prognostic value with respect to the student's progress in code.

There is indicated the need for a psychological analysis of the signal properties which are responsible for the confusions tabulated in this report. The basic problem is one of stimulus generalization, and some advance is being made in the identification of the most important stimulus determinants. The discussion of this matter may, however, be postponed until the practical consequences of such an analysis are clearer.

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A Note on the Reliability of the Revised Kuder Preference Record

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A revision of the Kuder Preference Record, which was first made available in 1939, was published in 1942. The items in the older form were based on the paired-comparisons technique. Scores were obtained on seven scales—computational, scientific, persuasive, artistic, literary, musical, and social service. Each of the items in the revised form presents three activities to the subject, who responds by indicating the activity liked most and the one liked least. In the revision, two scales—mechanical and clerical—have been added to the original seven.

Statistical data based on the older form of the Preference Record indicated that the reliabilities of the scales were fairly high. The revision is so recent that there has not yet been an opportunity to make an extensive study of its reliability. However, retest reliability data on the new form are available for forty-one students in a graduate class in standard tests. The students filled out the answer sheet twice with an interval of three days between the two administrations. The product-moment correlations between the test and retest scores are shown in Table 1. Reliability coefficients reported by Kuder [1] and by Traxler and McCall [2] for the unrevised form of the Preference Record are also given in the table for purposes of comparison.

The reliability coefficients for the revised Preference Record are unusually high. They range from .93 for the social service scale to .98 for the computational and clerical scales. Without exception, they are considerably higher than the Spearman-Brown reliabilities reported by Kuder and the retest reliabilities found by Traxler and McCall for the unrevised form. They may be spuriously high, for the time interval between administrations was so short that a memory factor was probably involved in the results. This limitation to the retest procedure was minimized in the data reported by Traxler and McCall, since in that study there was an interval of several weeks between the two applications of the Preference Record.

[1] G. F. Kuder. *Manual of directions for the Preference Record.* Chicago: Science Research Associates, 1939.

[2] Arthur E. Traxler and William C. McCall. Some data on the Kuder Preference Record. *Educ. & Psychol. Meas.*, 1941, 1, 253–68.

Table 1

Correlations Resulting from Two Administrations of New Revision of Kuder Preference Record at an Interval of Three Days
(41 cases)

Scale	r	P.E.	Reliability of Older Form		
			Kuder	Traxler and McCall	
				H. S.	College
Mechanical	.97	± .01	—	—	—
Computational	.98	± .01	.85	.81	.75
Scientific	.95	± .01	.87	.91	.78
Persuasive	.97	± .01	.90	.84	.80
Artistic	.96	± .01	.90	.86	.82
Literary	.95	± .01	.90	.86	.79
Musical	.95	± .01	.88	.88	.87
Social Service	.93	± .01	.84	.84	.59
Clerical	.98	± .01	—	—	—

It seems unlikely, however, that remembrance by the subjects of the way individual items in the Preference Record had previously been answered is in itself a sufficient basis on which to explain the high correlations. If the items did not sample interests that were fairly stable, at least for a short period, it is doubtful that memory of earlier responses would tend to raise the reliability. It might, in fact, have the opposite effect because under those circumstances one would feel dissatisfaction with the inventory and would tend to be highly critical of each previous response that could be recalled.

Because of the short time interval and the small number of cases, the correlations here reported should be regarded with considerable caution. Nevertheless, these data do suggest that the reliability of the revised Kuder Preference Record compares favorably with that of other measuring instruments of similar length.

A Practical Method of Using Set

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About a dozen years ago the writer undertook to see if *set* could be used to advantage in various life situations. Investigation took several forms. At first it was mostly trying out certain ways of employing set with clients in clinical practice. Then when war began, there were repeated requests from prospective aviators for help in passing the Schneider test; their trouble was that pulse rate and blood pressure ran up because of excitement and fear of not passing. College athletes also came with similar problems—how, for instance, can one keep cool and use his best skill in the excitement of a football game or boxing match? It was found that the set techniques used in clinical practice proved equally effective when adapted to aviators and athletes.

At the present time the method is being studied experimentally at a Navy "boot camp," especially to help the newly inducted seamen eliminate fear in learning to swim; and at a marine camp to aid paratroops in subduing the same emotion. The psycho-techniques are also being studied for the training of naval pre-flight cadets. It would be premature to attempt report on the experiments in the Navy and Marine Corps. The purpose here is rather to sketch and comment on the practical method of using set and to illustrate this by some reference to a preliminary experiment on boxers. From a scientific standpoint there should be more experimental returns, but war necessity makes it seem expedient to tell now what has been done and is being done. Perhaps other psychologists will be interested in participating in subsequent experimental work.

In this report the word *set* is taken to mean predetermining tendency or the verbalization of a predetermining tendency. However, the writer's conception of the term differs from most usage in scientific psychology in one important particular, viz., the set is established well in advance of the state or activity with which it is linked. An everyday example is found in the well-known experience of "setting" oneself before going to sleep to wake at a certain time next morning. It is comparable to post-hypnotic suggestion, but without the trance. A good name for this kind of set might be deferred-reaction set, or set in advance. Attitude is often a synonym. For instance, a flying cadet at Pensacola made a practice

of thinking to himself each evening that he would enjoy flying the next day. He accepted the idea with conviction and planned to go through his next day's flight work with real pleasure. And he always did. He believes that this attitude, or pre-disposition, brought the desired result.

The writer has tried practical sets in many ways personally and has also gotten what appear to be definite results. One example will show the operation of this kind of set. Since she had not learned to drive an automobile until middle life and is mechanically moronic, she felt that a serviceable set for driving emergencies would be in order. So this one was devised: "*Relax, think fast,* and *do what is necessary* if the need arises." The idea was thought over and thoroughly digested at those times when highway driving was monotonous and safe. There was a genuine belief that the set would work, because similar ones had been effective in other situations. At length the need did arise. There was a deplorable combination of rain, curve, high-crowned country road, haste, and inexperience. The sedan ran into an unmanageable skid, whizzed completely around, rolled over hitting all four sides, and came to rest far out in a ploughed field after a fifth quarter-turn.

From the instant the car left the road the set got under way. "This is it—relax" was the first thought. And the rest of the set, "think fast, do what is necessary," came into action when the car stopped and the occupant found herself sitting on the right door. A train of thought something like this followed: "Am I hurt? No—can't feel anything wrong. Now what shall I do? Oh, yes, turn off the ignition." (This particular realization was truly an achievement for in all her feminine ignorance of cars at that time, the writer failed to grasp the vital importance of stopping the engine. It was more the set acting compulsively.) "Now what?—Open the window. It's jammed a little, but I can do it. I can get my head out at least.—No one around.—I'll call for help.—I can hear them starting a car at that nearest farmhouse. Must be coming for me. . . . Yes—I'll call some more to be sure.—Man, woman, and boy. How horrified they look! No, I'm not 'terribly hurt,' not hurt at all."

There was a satisfied feeling of being relaxed enough to be cool and collected but at the same time alert to "think fast and do what was necessary." The set seemed to be in full action. The man was requested to telephone the nearest A. A. A. garage, and while he was gone the set provided a decidedly compulsive chain of ideas: "I must get all these strewn papers picked up and that conglomeration from the glove compartment. Must have everything ready for the garage man to take the car. And where is my hat?—Away back under the rear window. Guess I can retrieve it with the umbrella. Can't give a lecture in San Francisco tonight without my hat.—What is that woman out there

talking about? Afraid I'll burn up? Of course not—the engine isn't running. I'd better soothe her a bit.—Nothing to get excited about. It's just an interesting experience. . . ."

It is hoped that this circumstantial account makes clear what is meant by set and shows that it can be most active. The after-condition of the sedan and its owner was further testimony to the effectiveness of the set. The car, though new and equipped with a strong steel top, was so badly wrecked that this had to be entirely replaced; but the owner suffered no injury other than two bruises of very moderate proportions. There were no shock effects. In the absence of a control the incident is offered by way of description rather than evidence. However, it should be noted that there was at times a definite introspective feeling that the set was operating, and always an undercurrent of compulsion in accordance with the set.

We can turn now to the experiment on boxers. The first suggestion that psychology be used to help student boxers came from them. After there were some marked successes, the boxing coach at San Jose State College, DeWitt Portal,[1] urged the writer to form a class in psychology for athletes and aviators. As a by-product of this and following successful results in the novice tournament, an experiment was set up. Mr. Portal selected six apparently evenly matched pairs. One of each pair was "psychologized" by the writer; the other acted as a control. Five out of six of the "psychologized" group won, and with the only non-winner it was nearly a tie. In the intercollegiate contests the San Jose boys won every time, which was indeed remarkable when one considers the opponents, viz., the University of California, California Agricultural College, Stanford University, Mather Flying Field, and the Tanforan soldiers coached by none other than Max Baer. San Jose is a small college and with one exception the boys were all this year's novices. Not only was there in general great disparity in numbers from which to draw, but there were other serious inequalities. And in mid-season San Jose lost its excellent coach to the Navy. But the San Jose boys won with KO's and TKO's and always by a comfortable margin.

The psychological method used to help produce such results need be outlined only briefly since it will be fully explained elsewhere. The first step is to develop a background for strong faith in the techniques. The operator should preferably be a person of prestige, or at least one who is liked and respected and who inspires confidence. Enthusiasm and belief on his part are requisite. He should give examples of successes by means of the method and in general be a good salesman for it. When

[1] Now Lieut. (j.g.) Portal, head of Boxing Department, Navy Pre-Flight School, Athens, Ga.; and president of the National Intercollegiate Boxing Coaches Association.

there are groups, these should be kept small and chosen by invitation only. It must be stressed at the outset that each person is to "give it all he's got."

In actual procedure the first thing is to show the subject how to relax fully. He is requested to let his mind dwell on some word such as "calm," "peace," "serenity," or just the word "relax" itself. Then he is asked to relax more and more, or "progressively," as Jacobson [2] puts it, beginning with the head and working down through the body and extremities. Though the writer has great admiration for Jacobson's work, her method differs in that she stresses the mental as well as the physical. The subject is shown how to calm his mind while he relaxes his muscles on the theory that each helps the other. Clinical evidence shows that results are obtained much more quickly this way than simply by artificial and meticulous concentration on each muscle group. Natural physical relaxation is habitually accompanied by a peaceful state of mind.

Certain "calming" devices are used. A quiet room is chosen and, when possible, a comfortable chair or couch is supplied. The subject is asked to keep his eyes closed to shut out distractions. The operator keeps his voice low and soothing. The subject is sometimes asked to visualize a restful scene, such as a place where he likes to fish; or to think of a person who has a quieting effect on him; or, perhaps, to visualize himself as relaxed, happy, and tranquil.

There are two reasons for learning to relax. One is that knowing how to relax is knowing how to control emotionalism, a major problem of service men and athletes. The other reason for relaxing is bound up in that modern version of the old ideo-motor theory, the newer motor theory of consciousness. Whether or not one wholly subscribes to this is immaterial. At least it is unquestionably true that much of thinking leads to, or is accompanied by, muscle tension. Conversely, cultivating mental inactivity is likely to result in a relaxed musculature. It seems wise, then, to use the relaxed state when not much thinking is likely to be in progress, as a time for implanting desired ideas, on the ground that there will be little competition. Presumably the ideas become more firmly established when there is this preparatory relaxation. At least the whole procedure works extraordinarily well. The factor of relaxation should, however, be isolated for careful experiment.

When the subject is thoroughly relaxed, the set is offered in some such fashion as the following:

"Tomorrow when you begin the infiltration course you will keep cool, think fast. Calm and alert all the time. You will remember what you

[2] Jacobson, E. *Progressive relaxation.* Chicago: Univ. of Chicago Press, 1929, and Jacobson, E. *You must relax.* New York: McGraw-Hill, 1934.

have been taught to do. You will keep cool and use your head. That's all that matters—keep cool and think fast—keep cool, think fast," etc., etc.

It is well not to attempt more than one or two basic ideas at a sitting. They are repeated with some variation, as in the sample just given, in order to avoid monotony, but the same words are reiterated frequently. These verbalized sets have been carefully chosen earlier after discussion with the subject and analysis of his problems. Much turns on the ability of the operator to diagnose difficulties. The verbalized set must represent the heart of the problem and be adapted to the individual's needs and understanding. Under many circumstances members of a group will want the same sets. Some of the boxers' sets were: "keep cool, be alert"; "think fast and use all I have"; "remember all I have learned"; "use all my reserves of physical power"; "calm, cool, and collected." They are expressed positively so as to avoid suggesting the unwanted opposite.

A useful additional device is to have the sets typed on 3 by 5 cards, which the subject can carry around with him to go over from time to time. The writer's attention was first called to the value of such written slogans after World War I in working with war neurotics.

After about ten minutes of impressing sets, an interval of complete quiet is allowed for settling, or consolidation of the thought. The subject is also instructed to go over the ideas each night for a while before falling asleep. In addition, he should if possible review them briefly upon waking in the morning and before a rest period during the day. Any other times are useful, but times before sleep or rest are particularly effective. The reader will understand that this procedure of impressing an idea before sleep or rest is based on the experimental findings of van Ormer [3] and others in regard to the slowing down of forgetting during sleep; and also on the extensive evidence on interference as a cause of forgetting. This hypothetical basis should, of course, be supported by experimentation in which the particular factors here involved are properly tested.

The final step in the whole process of establishing sets is very important but can be expressed briefly. It is this: success should follow promptly. In other words, there must be speedy opportunity to test the method because succeeding will insure confidence and further successes.

If we now sum up the steps in the procedure, they are: (1) every effort is made to create an atmosphere which will produce conviction of success through the method; (2) the subject is shown how to relax; (3) slogan-

[3] van Ormer, E. B. Retention after intervals of sleep and waking. *Arch. Psychol., N. Y.*, 1932, 21, No. 137.

like ideas are presented; (4) rest or sleep follows; and (5) occasion for success must be provided quickly.

The operator actually needs to work with the subject only once, for after that the latter can usually continue alone. However, before contests, combat, or other times of stress the operator may be needed. There has been a good deal of amazed comment on the quickness of results. The boxing coach frequently praised over-night successes. This speediness is probably due particularly to the strong initial feeling aroused that there will be success and to the emphasis on self-activity. It is insisted that the subject must "do it himself." He must give vigorous, whole-hearted attention to the sets. "As a man thinketh, so is he," is often quoted. And it is added that a single-trackness of mind, an ability to keep intently to one field of thought, is characteristic of genius. This is not only true but also carries a flattering implication that the subject is himself of the same stuff as genius.

It may be well to point out to the reader, as it often is to the subject, that the method is far from being what is usually known as suggestion. This is rightly criticized as something mechanical. It is the operator, not the subject, who is active. In ordinary suggestion the subject accepts an idea uncritically and responds automatically. But what the writer is using is something essentially dynamic. The subject is passive only in the sense that he is receptive. He must be very active in wanting the ideas, going out to embrace them, making them his own, and they must spring from his own recognized needs.

The author had long been impressed by the potentialities of post-hypnotic suggestion. But there are obvious objections to hypnotism. Many persons cannot be hypnotized readily, if at all. Many more are afraid of hypnotism. Injurious suggestions may be offered intentionally or unintentionally. The solution seems to lie in creating the same conditions without the hypnotic trance as with it. What is wanted is intense, unified attention, and it has become clear that this can be developed in the waking state. There are also certain advantages in "the waking trance," as we might describe the product of the procedure used here. The subject can formulate, edit, and renew suggestions at will. He can enhance and prolong original effects by subsequent attention. He may thus actually supplement "the waking trance," something which would not be possible with the hypnotic trance. In fact, "trance" is a word of dubious descriptive value for the author's concept, since "trance" implies a sleep-like state followed by amnesia for the events of that state. In this connection it may be noted that W. R. Wells advocates what he calls "waking hypnosis" for class-room demonstrational purposes.[4] He

[4] Wells, W. R. Experiments in waking hypnosis for instructional purposes. *J. abnorm. Soc. Psychol.*, 1924, 18, 389–404.

does not consider the practical developing of attitudes. He appears to mean by "waking hypnosis" what is usually described as an extreme degree of waking suggestion, as Salter points out.[5]

The relation of set and habit is also pertinent. Experimental psychology is voluble on the subject. Gibson [6] finds an ambiguity in concepts of set as being used originally to mean a selecting agency opposed to habit, but later, especially in this country, as itself a habit. In the writer's judgment the ambiguity is real but immaterial. Some sets are habits; others are not. Use of the word set is legitimate in both cases because the fundamental meaning is still there, viz., that "the before" influences "the after." In the writer's practical use of set the important thing is to establish it as a habit for future use; an enduring set to evoke a set at the time of need—a set for a set.

This set-for-a-set seems to be, in part, back of the interesting compulsive quality remarked on in this article. There is the expectation (or set) that the set will work. But compulsiveness is also due to the learning which is carried on in such a way as to utilize the principles of frequency and intensity to the utmost. In other words, there is constant repetition of the idea and every device is used to reinforce its vividness. Strength of impression plus expectation leads, then, to the compulsive quality.

Anyone who has any doubts about the importance and prevalence of sets should read Dashiell's excellent article [7] in which he says:

> We see, then, that there are many kinds of sets! Some are wider in scope, are more general, than others. Sometimes they coöperate and reinforce, sometimes they antagonize and inhibit each other. So that a complete picture of how John Doe is set at a given instant would be a composite picture indeed!

This citation has a bearing on the debated question as to whether sets are centrally or peripherally located, and leads back to the motor theory of consciousness. The distinction of "phasic" and "postural" types of muscular response proposed by Dashiell is fascinating but still leaves certain practical issues. Granting that sets are very numerous and assuming they always mean muscle tension, should we not conceivably be unable ever to relax completely and all exist in a perpetual state of tonic spasticity? Or, if the various sets shift and change, as would seem probable, would not life be one long series of minor con-

[5] Salter, A. Three techniques of autohypnosis. *J. gen. Psychol.*, 1941, 24, 423–438.

[6] Gibson, J. J. A critical review of the concept of set in contemporary experimental psychology. *Psychol. Bull.*, 1941, 38, 781–817.

[7] Dashiell, J. F. A neglected fourth dimension to psychological research. *Psychol. Rev.*, 1940, 37, 289–305.

vulsions? Or, worst thought of all, would not antagonistic sets produce a muscular deadlocking likely to leave us helpless? The peripheral locus of an immediate set is easy to conceive, but long-time sets are quite another story, and one in which the mystery has as yet no clear solution. The writer says this regretfully, being much attracted to the motor theory of consciousness.

Dashiell performs a real service in calling attention to the importance of set in his apt description of it as the "fourth dimension to psychological research." The writer wants to add a plea for the practical cultivation of sets. Since we inevitably have so many of them, why not make them usefully productive? Sets could be to the mind what hormones and vitamins are to the body. Instead of depending on chance factors for sets, we might deliberately choose and establish desirable ones. It is a matter of systematically directing attention to definitely formulated ends. The procedure described here is not essential, but many persons who depend on spasmodic good intentions, would do better with a regular and specific program.

How far can one go in using practical sets is a question many ask. Certainly not as far as one of the writer's clients believed. She had to have it carefully explained that no amount of thinking about money would conjure it out of the blue horizon without effort on anybody's part. It required strong argument to convince her that psychology was not magic. As a matter of fact, serviceable sets are rather likely to turn around two points, control of emotions, and direction of attention. Sets for relaxation, calmness, and confidence, and for concentration and alertness are particularly popular. But one could continue indefinitely on matters of content, form, and presentation of sets. The whole subject is at present open to experimental study and clinical observation.

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Speech Training for the Armed Forces *

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The following is a statement by the Adjutant General of the War Department in an open letter to the President of Pennsylvania Military College:

A great number of men have failed at camp because of inability to articulate clearly. A man who can not impart his idea to his command in clear distinct language, and with sufficient volume of voice to be heard reasonably far, is not qualified to give commands upon which human life will depend. Many men disqualified by this handicap might have become officers under their country's flag had they been properly trained in school and college.

Such a statement is very similar to those announced by deans of colleges discussing the qualifications considered in choosing their teaching personnel. In colleges, however, it is notorious that the rank of the teacher is in no way related to his lecturing ability. The opinions expressed by deans are at variance with their actions in recommending promotions. A like situation could exist in the Armed Forces. And should some such condition exist, now is the time to remedy it. So this paper will undertake to report an effort to measure the speech function in relation to military proficiency as indicated by achievement, rank, etc.

In order to ascertain the need for speech training for the armed forces in war time, and not interrupt Army schedules, a study was undertaken of the speech habits and skills of the Reserve Officers Training Corps at Oklahoma Agricultural and Mechanical College to demonstrate the requirements, types, importance, and province of the work of speech teachers.

This study of the speech habits of R. O. T. C. cadet officers included a clinical analysis of the frequency and effect of speech disorders on military trainees, a careful subjective investigation of the relation between speech habits and ability in giving military commands, and a statistical study of the relation of the grades in fundamental courses in speech, English, and mathematics to military grades. Grade in military science is interpreted as an index of, or reward for, military achievement. An individual speech examination was given to 255 cadet officers in the

* Thanks are due Col. Howard McC. Yost, the late Lt. Paris Perswell, and Mrs. Ernestine Leverett who helped to work out this problem.

advanced R. O. T. C., which included an analysis of articulation, pronunciation, inflection, voice quality, fluency, ability in making oral military reports, ability in giving commands, and ability in reading military announcements. The test procedure was that which has been used in examining thousands of college subjects in freshmen surveys and the ratings were clinical rather than objective (reliability, .897).[1]

Each cadet officer reported orally in answer to a series of questions. Then he gave the commands necessary to form a company and move out for drill. Finally he read an announcement. He received a rating of 1 (inferior), 2, 3, 4, 5, 6, or 7 (superior) on his ability in each of these three performances and also a like rating on articulation, pronunciation, inflection, voice quality and fluency. Articulation was assumed to mean explicitly the arc of movement of the lips, jaw, tongue, and velum through phonetic configurations and hypha. Anatomic anomalies of these four functional organs and their associated proximal organs were also considered capable of modifying articulatory ratings. Pronunciation was defined as auditory in contrast to the visual gestures of articulation, and was construed to mean the acoustic phonemes. Inflection was conceived as more than the traditional construct of pitch pattern and range and instead the newer Voelker theory was accepted. This broader concept imputes inflection to be the pattern of overt action and mood of covert set of the organism as a whole, particular attention being given to the pitch patterns of the larynx, affective play of the muscles of expression, and the method of approach of the articulators. Psychologically, it was postulated that fluency included the behavioral adjustment of the organism to the speaking situation.

Results

There were no severe speech defects found in the 255 cadet officers examined and not enough mild defects were found to warrant any conclusions. The cadet officers were found to have a normal distribution on each of the speech habits. The principal findings are reported in Tables 1 to 5.

Ability in giving military commands and achievement in military science was not found to be a function of any one speech habit. Grades in college courses in mathematics, English, and speech had no relation to achievement in military science. Grades in college courses in English, mathematics, and military science showed no relation to the present examination of speech habits and skills, but grades in the basic college speech course gave a reliable prediction of the composite rating on the

[1] Voelker, Charles H. Two surveys of speech in a cultural college. *J. Amer. Ass. Coll. Regist.*, 1938, **14**, 39–42.

present speech examination. Rating in the ability to give commands predicted fairly well the composite score on the whole of this speech examination. Grades in college English were found not to be related to grades in college speech.

Table 1

The Rating of 255 Cadet Officers on 5 Basic Speech Habits and 3 Forms of Speech Skill on the Scale of 1 to 7

Type of Rating	Average Rating	Range of Ratings
Articulation	4.3	2 to 6
Pronunciation	4.7	2 to 7
Inflection	4.3	2 to 7
Voice Quality	4.0	2 to 7
Fluency	4.0	2 to 6
Reports	4.0	3 to 5
Commands	4.1	2 to 6
Announcements	4.3	2 to 6

Table 2

The Relation of Ability in Giving Commands of Cadet Officers to Speech Habits and Skills and Military Achievement

Number of Officers	Category	Correlation with Ability in Giving Commands	
255	Articulation	.19	±.06
172	Pronunciation	.11	±.06
255	Inflection	.24	±.06
255	Voice Quality	.36	±.05
255	Fluency	.19	±.06
255	Reporting	.01	±.06
255	Announcing	.14	±.06
252	Military Grades	.01	±.06

Table 3

Showing the Relation of Grades Received in Four Subjects by the Cadet Officers to Their Achievement in the Speech Examination (The 8 Factors Included in a Composite Form)

Number of Cadet Officers	Subjects	Correlation of Grades with Speech Examination	
255	Military	.36	±.06
143	Speech	.89	±.02
94	Mathematics	.39	±.08
234	English	.35	±.06

Table 4

Showing the Relation of Ability in Giving Commands as a Function of Speech Habits for the 25 Highest and the 25 Lowest Cadet Officers in Speech Habit Ratings

Group	Speech Habit	Mean Rating in Speech Habits	Mean Rating in Ability in Commanding
High	Articulation	5.9	4.5
Low	Articulation	2.9	4.0
High	Pronunciation	6.1	4.3
Low	Pronunciation	3.1	3.7
High	Inflection	6.0	5.0
Low	Inflection	3.1	3.6
High	Voice Quality	5.6	4.7
Low	Voice Quality	2.8	3.8
High	Fluency	5.1	4.3
Low	Fluency	3.0	3.8

Table 5

The 25 Most Superior and the 25 Most Inferior Cadet Officers at Ability in Giving Military Commands, Showing Respective Mean Rating of the Two Groups in 5 Speech Habits

Abilities	High	Low	Per cent Difference
Articulation	4.6	4.0	8.6
Pronunciation	5.0	3.7	18.6
Inflection	4.7	3.8	12.9
Voice Quality	4.6	3.5	15.7
Fluency	4.5	3.8	10.0

The mean rating of the 255 cadet officers showed that they were average in basic speech habits with the exception of pronunciation, which was slightly above the average. The average ratings in the three skills believed to be related to the performance of military duty were also average. Ability in giving commands was related to no particular habit or skill other than the ability to give commands. The cadet officers who rated highest in any speech habit, as a group, consistently rated high in ability in giving commands. Those cadet officers who were most superior in ability in giving commands were consistently superior to the cadet officers inferior in giving commands in all five basic speech habits, and the rank order of difference from the greatest to the least was pronunciation, voice quality, inflection, fluency, and articulation. Military

rank had no relation to any rating in the speech examination; which is to say that the colonels were no better than the sergeants, etc.

Implications

If speech has any relation to achievement in military science and ability in giving commands this study has given no indication of it. It would seem that high ability in speech habits and skills is not in itself sufficient and adequate to be a prerequisite for military training. This study does not indicate, however, that training in commands should not be a sub-course content for the cadet officer's training but it does indicate that any ability they gain from this sub-course in giving commands guarantees in no way any particular level of achievement in military science. It would further seem that ability in giving commands is not particularly fundamental as a basis for recommendations for military training or induction into the army. This study would seem to indicate that ability in speech is not needed by draftees other than that perhaps the present Army physical standards are adequate regulations in regard to handicapping and disabling speech defects.

Whether or not any Army training program should include speech training is not exhaustively indicated here, but certainly the information herein would not recommend it. This does not mean that specific training in giving commands, directions, reports, and making announcements should not be given consideration in the training of officers. But certainly officers and officer candidates do not require special achievement or training in fundamental speech habits, or in public speaking. There is no background work needed in basic speech habits. No associated skills in speech need to be considered. This is no isolated example, since it is generally agreed in advanced educational circles that if a student is to be trained in any specific skill, he must be given training in that skill, and not in different skills in the hope of transfer of training. It is only within an institutional situation that administrators overlook such a view in their efforts to divide artificially the educational process into three hour semester courses, which situation demands the inclusion of unnecessary background content to fill up the whole of the seventeen weeks allotted to the subject.

Obviously no speech corrector or pathologist is needed in army service from the induction board or through the service. Perhaps specialists in speech correction might find some duties in eliminating speech defectives from the ranks of the men who have received their draft call, or in correcting speech disorders in civilians before they receive their draft call so that they could pass their physical examinations.

Beyond the question of who is to be drafted it would seem that it should be concluded that the subject of defective speech habits is in no

way the concern of the armed forces. And the Federal Board of Hospitalization Policy, since September, 1940, has eliminated the Armed Forces from concern with speech defects incurred during military duties.[2] The present policy is to dismiss such men from the Service. Thus speech defects give concern only before being drafted or after dismissal from the service.

It is unfortunate for the morale of speech teachers that the study had to come out negative. Would that it could have been demonstrated that what was needed to win the war was speech; then the speech teacher, like many others, could remain in his same groove and rationalize that he was being important to the cause. But it should be stated that this study indicates more than anything else a need for more objective study. Speech may be only one of so many factors that its part was concealed by the statistics rather than brought out. It is fair to suppose that an army officer might be an even better army officer if he were trained to speak more effectively. Certainly, there have been some good speeches given by officers in the services, but on the other hand, certainly, there have been instances where confusion, and even disaster, in action have resulted from inadequate speech by officer personnel. Perhaps, what is indicated is that the services talk about clear speech, but as yet have not been able to get it. Maybe, they need experts to see that they get the good speech they want.

It is important to indicate that the local Army officers were of the opinion that speech was very important in military training. They give sub-courses in speech. They call in a speech specialist. Furthermore, the War Department has emphasized the importance of speech training. West Point, Annapolis, Leavenworth, and other camp schools have introduced speech courses of a very intensive nature. Trainees have been dismissed from certain specializations (bombardier, etc.) because of poor speech.

[2] *Annual Report of the Administrator of Veterans Affairs for the Fiscal Year Ended June 30, 1940.* Washington, 1941, page 1.

Measuring the Radio Audience by the Personal Interview Roster Method

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At the present time, there are in regular use four accepted methods of measuring the radio audience. They are, in their historical order, as follows:

1. *Telephone Recall* in which homes are called on the telephone and asked about radio listening during a given elapsed period of time. (C.A.B., 1931) [1]
2. *Telephone Coincidental* in which homes are called on the telephone at random and asked about radio listening at the moment of the telephone call. (Hooper, 1938, now also C.A.B., 1941) [1]
3. *The Personal Interview Roster* in which during a personal interview, the respondent is shown a list of programs for identification of those which were heard. (Pulse of New York, 1941) [1]
4. *Radio Meter Record* in which a recording apparatus is wired into the radio and a record made of the set's operation. (Nielsen, 1942) [1]

Each of these methods has certain advantages and disadvantages. Although it is the purpose of this paper to describe primarily the roster method, for the sake of contrast a brief statement of the merits and difficulties of the other three methods is given here.

The principal value in the use of the telephone recall method is the economy with which a large amount of listening data may be collected. It is also a means of obtaining a quick survey. The telephone recall may be criticized most severely, however, because measurement obtained through its use is based upon a selected portion of the population. Since radio ownership is well over 90 per cent, but telephone ownership is under 50 per cent (these figures vary depending upon communities surveyed), it is at once apparent that a large share of the radio market is not included in such measurement. Furthermore, there are differences not only in the listening habits but in other forms of behavior between telephone subscribing and non-subscribing homes. Although the C. A. B. attempts to stratify its telephone calls among four economic levels, in an effort to obtain a representative cross-section, it is difficult to classify

[1] The dates are the approximate year in which the method was used in a regular research service.

homes on an economic basis by knowing only the address. In addition one might ask how many among the low economic levels possess telephones so that they can be included in a stratified telephone sample adequately. Although some have criticized the telephone recall because of the loss of memory involved in an unaided recall, it is questionable whether this criticism is valid when the recall period is a short one.

About the only advantage the telephone coincidental method can claim over the telephone recall is that it overcomes the so-called error introduced by the memory factor. However, the telephone coincidental method introduces other errors which are even more serious. For one thing, making telephone calls at random can in no way insure that equivalent samples are obtained for each quarter hour program. Furthermore, it is difficult to make a large enough number of calls in a given 15 minute period unless an exceptionally large staff of telephone interviewers is employed. Indeed, large fluctuations do occur in the ratings of successive quarter hours on the same program and they are most likely caused by these two additional factors.

The meter method lays claim to being truth. There can be no doubt that, if the meter records while the radio is on, an accurate record is being made. However, this truth is a physical truth and not a psychological truth. The fact that the radio is on does not necessarily mean that any person is listening. The meter is a very costly method since it will require a large number of meters in operation simultaneously to produce usable ratings. It matters little that in the course of a year, a few meters can produce a record equivalent to millions of coincidental interviews. What is needed is a sufficient number of cases so that a given quarter hour program can be measured for a definitely limited period. An average of several months is meaningless because conditions change. An average over a large geographic area is also meaningless because local competitive conditions differ. In each of these instances the true state of affairs is obscured by the process of averaging. The meter like the telephone can only reach a certain selected part of the population. In the case of the meter, only those homes which are willing to cooperate will permit the installation of the meter. Furthermore, the pattern of listening is affected by the conscious awareness that a permanent record of the listening is being made.

This brief account of the difficulties inherent in these three methods of radio measurement is not intended to minimize their usefulness. No one method can ever be perfect. Depending upon the obstacles in the way of research and the purpose of research, each method will have its place and can make its contribution in studying the radio audience. The purpose of the present article is to describe briefly a technique used in

the writer's organization which have some advantages. It consists essentially of a preliminary interview in order to determine at what time of day the person was actually listening and then presenting to him a list or roster of the programs which were on the air at that particular period with further questions regarding them.

In 1935, a dramatic change in the nature of a program sponsored by an advertiser occurred without the usual intervening time period (summer season). Eddie Cantor, who had been plugging for Chase & Sanborn Coffee, was discontinued and the sponsor inaugurated a series of opera programs instead. In order to study the changes wrought by such a switch, a small survey was made (1). What was needed was a reliable and adequate measure of listening in order to note and evaluate any differences which occurred.

Although this survey was a small one, it was not planned as a small one. It was made by the personal coincidental interview method. The practical problem, of obtaining a large enough field staff so that a great many interviews could be made during the short time the program was on the air, was too great. For accurate measurement of the radio audience, a method was needed which could economically afford a large enough sample and which could be practically operated. The personal coincidental interview method did not fulfil these conditions and furthermore it could not be controlled so that representative and equivalent samples could be obtained for each quarter hour. The telephone was obviously out of the question.

In the years which followed, the roster method was developed and offered promise of overcoming the above objections. A great step forward was made in 1939 when the Psychological Corporation studied The Buffalo Radio Audience by means of the roster method and personal interview (2). The roster as utilized here was a list of programs by the quarter hours in which they were broadcast. Rosters then may be briefly summarized as lists of programs. Numerous studies have been undertaken using lists of programs which are shown to respondents who then answer questions dealing with the programs listed.

The abuse of the roster method arises from the nature of the list of programs constructed and the questions which are asked. This writer is entirely aware of the fact that by *strategically* worded questions almost any desired response may be obtained (3, 4). The roster method has been criticized because it yields results influenced by the memory factor and because "big name" shows are inflated and relatively unknown programs are deflated. This is undoubtedly true because those studies which produced such results employed rosters which could not do otherwise.

For example, if a roster is only *thought of primarily in connection with radio surveys because it provides a means of exhibiting a list of programs to*

a respondent in conjunction with such a question as: "Did you listen to any program on that list since this time yesterday?" (5), then we are abusing the roster method. This cannot be impartial and scientific research because this approach knowingly produces exaggerated ratings in one instance and minimal ratings in another.

Suppose we consider this list as a roster:

WEAF	Jack Benny	Sunday	7:00– 7:30 P.M.
WJZ	Lowell Thomas	Week Days	6:45– 7:00 P.M.
WMCA	Three Quarter Time	Week Days	9:15– 9:30 A.M.
WOR	Gabriel Heatter	Week Days	9:00– 9:15 P.M.
WNEW	Sam Cuff	Week Days	12:15–12:30 P.M.
WABC	The Family Hour	Sunday	5:00– 5:45 P.M.
WEAF	Melodies at Midday	Week Days	12:15–12:30 P.M.

When this list is shown the respondent with this question, "Which of these programs do you listen to frequently?", certain results are obtained. Such a roster deliberately produces desired results. No one listens frequently to Three Quarter Time, Sam Cuff or Melodies at Midday. Indeed, who can remember listening to these when at the same time he is confronted with Jack Benny, Gabriel Heatter and Lowell Thomas! These programs do not really compete with each other because they are not broadcast at the same time. Comparing the percentage of one with any other in this list is meaningless. Certainly the percentages are not ratings. Furthermore, the psychological meaning of the word *frequently* is variable.

This list and question was actually asked in an experimental survey with the following results:

Jack Benny	64%
Lowell Thomas	72%
Three Quarter Time	—
Gabriel Heatter	84%
Sam Cuff	4%
The Family Hour	23%
Melodies at Midday	—

Such a roster used in this way cannot give reliable measurements and cannot be used for any purpose which employs the results in any way as measurements. Actually, the ratings for the same period of the above survey as determined by The Pulse of New York roster method are as follows:

Jack Benny	30.3
Lowell Thomas	8.7
Three Quarter Time	.3
Gabriel Heatter	12.0
Sam Cuff	.9
The Family Hour	4.6
Melodies at Midday	.9

The use of a roster like the above is legitimate only if the results are employed not as ratings but rather as a means of finding listeners to given programs in order to ask further questions of these listeners. Thus, the following roster has been used in a survey in order to find listeners to certain programs on the list. These listeners were then questioned about their likes and dislikes about the programs. In this case, the roster was not used for the measurement of audience size.

Which of these programs do you listen to frequently? (Show, read and check)

Cities Service Concert—Lucille Manners—WEAF—Fridays 8 P.M. .....
Hour of Charm—Phil Spitalny Girl Orch.—WABC—Sundays 5 P.M. .....
Voice of Firestone—A. Wallenstein Orch.—WEAF—Mondays 8:30 P.M.....
The Telephone Hour—Don Voorhees Orch.—WEAF—Mondays 9 P.M.....
The Old Gold Program—Nelson Eddy—WABC—Wednesdays 8 P.M.....
Prudential Family Hour—Gladys Swarthout—WABC—Sundays 5 P.M.....
Coca Cola Program—A. Kostelanetz Orch.—WABC—Sundays 4:30 P.M.....

Although the roster as described above, the *abused roster*, cannot be utilized to yield reliable or valid measurements of audience size, nevertheless, it has been so employed and in these instances there is no question about the distortion introduced. But the roster method can be used to measure the radio audience if a scientifically psychological approach is used. The roster, as a yardstick for impartial measurement, is a listing of programs and stations by quarter hour periods. The following is an example:

9:15–9:30 A.M.

WOR —V. H. Lindlahr—Health Talk
WABC —American School of the Air
WHN —Weaver of Thought
WINS —Phil Cook
WMCA—Three Quarter Time
WNEW—Zeke Manners Gang
WEAF —Everything Goes
WQXR—Morning Musicale
WOV —The Cipuduzzas
WJZ —The Breakfast Club

In using the roster, the first step is to determine when the radio was on for a given period of time. For example, for the morning period, the interviews are made at 12 noon. The respondent is not asked simply which programs were heard. Rather, she is led by means of a few questions to reconstruct in her mind the activities of the morning, who was home, and when the radio was on connected with those activities and people.

Such questions as the following are employed:

When did the family awaken?
When was breakfast time?
When did the grown-ups go off to work?
When did the children go to school?
When did the housewife turn to her breakfast dishes?
When did the housewife do her housecleaning?
Did she go out shopping or marketing—when?
When did she return?
When did she begin to prepare for lunch?

The association of the radio with these normal and quite regular activities assist in recalling the times when the radio was on. When these times are established, the roster is shown for these periods. Assuming it was determined that the radio was on at 9:15 A.M.–9:30 A.M., the interview would proceed like this. "Here are the programs broadcast at 9:15. Let us look at them. Let's look at these just before 9:15 and just after 9:30 as well. Which of these or other programs did you and other members of the family listen to?" If necessary the programs and stations are read to the respondent. A similar reconstruction of activities is developed for afternoon and evening. The interviewing is always done immediately at the close of the roster period except for night programs. For these programs the interviewing is done the next morning at 9 A.M. This use of a roster which presents programs in their natural setting, that is, programs which are on during the same quarter hour, yields results which may be considered measurements of size.

Where the personal coincidental interview method is too costly or too difficult to handle in the field, the personal roster interview is available. The two methods, of course, do not measure precisely the same thing. The coincidental is an instantaneous average, whereas the roster is an over-all figure for any part and all of a given quarter hour. If the respondent had turned off his radio a moment before, or had turned on his radio a moment after, the interviewer called, he is counted as a nonlistener by the coincidental method. The roster method, however, would credit him as having listened during some part of the quarter hour. Tables 1 and 2 present results obtained by the personal roster and the personal coincidental interview. These ratings are the percentages of radio homes interviewed listening to each program. These figures are percentages based on all radio homes. Since comparable and equivalent samples of radio homes are interviewed for the different periods of the day, the ratings are comparable from one part of the day to another. The ratings produced by the two methods do fluctuate. Yet, the agreement between them is remarkably high. The programs and stations are ranked almost in the same order by both interviewing methods. There

Table 1

Comparison of Ratings Obtained by Roster and Personal Coincidental Interviews

August, September, October, 1942
Monday to Friday

9:00 to 9:15 A.M.		Roster	Coincidental*
WABC	News, G. Bryan	2.5	2.7
WEAF	Show Without a Name	1.1	1.8
WHN	Dance Orch.	.3	—
WINS	News, Phil Cook	.1	—
WJZ	Woman of Tomorrow	2.0	2.7
WMCA	News, F. Martin, Misc.	.7	—
WNEW	Zeke Manners Gang	1.6	2.7
WOR	Dear Imogene, Parsons	1.0	1.8
WOV	The Cipuduzzas	.7	.9
WQXR	Women at War, Music	.8	.9
Misc.		1.3	.9
Sets-in-Use		12.1	14.4
No. of Interviews		4,500	112
11:45 to 12 Noon			
WABC	Aunt Jenny's Stories	6.5	7.0
WEAF	David Harum	2.5	2.7
WHN	Musical Interlude	.3	.5
WINS	H. Sylvern Orch.	.3	—
WJZ	Blue Band Stand	.8	.3
WMCA	Insurance Box	.2	—
WNEW	Bing Crosby	3.9	2.8
WOR	Bessie Beatty	2.0	2.0
WOV	Diana Baldi	.9	1.0
WQXR	Concert Stage, News	.9	.5
Misc.		1.3	.8
Sets-in-Use		19.6	17.6
No. of Interviews		4,500	400
12 Noon to 12:15			
WABC	Kate Smith Speaks	7.1	6.2
WEAF	D. Goddard—News	1.2	1.5
WHN	News	.3	.7
WINS	News	.2	—
WJZ	Blue Band Stand	.8	.7
WMCA	News, Magic Carpet	.7	.2
WNEW	F. Froeba—Piano	1.2	1.1
WOR	News—B. Carter	1.7	2.2
WOV	News, Cont. Melodies	.5	.2
WQXR	Luncheon Concert	.3	.4
Misc.		1.0	1.3
Sets-in-Use		15.0	14.5
No. of Interviews		4,500	455

* The not-at-home visits are included in the base.

Table 2

Comparison of Ratings Obtained by Roster and Personal Coincidental Interviews

		Roster	Coincidental
August, September, October, 1942 Monday to Friday			
5:45 to 6:00 P.M.			
WABC	Ben Bernie	2.1	2.6
WEAF	Front Page Farrell	2.0	1.9
WHN	Dick Gilbert	1.0	.7
WINS	Stan Shaw	.4	—
WJZ	Capt. Midnight	1.5	1.6
WMCA	W. King Orch.	.3	—
WNEW	Make Believe Ballroom	4.6	4.2
WOR	News, Music	1.5	1.3
WOV	La Perla Program	.6	.3
WQXR	Great Masters	.8	1.3
Misc.		1.0	.7
Sets-in-Use		15.8	14.6
No. of Interviews		4,500	308
6:00–6:15 P.M.			
WABC	News	3.9	4.2
WEAF	Funny Money Man	1.0	.6
WHN	Capt. Tim's Club	.4	.2
WINS	Racing Resume	.7	.6
WJZ	News, Sports	1.1	.8
WMCA	News, Music	.5	.4
WNEW	Make Believe Ballroom	5.2	5.0
WOR	Uncle Don	1.4	2.2
WOV	News, Pan Americana	.4	.4
WQXR	Music to Remember	.8	.4
Misc.		.9	.6
Sets-in-Use		16.3	15.4
No. of Interviews		4,500	497
July, August, September, October, 1942 Thursday			
8:00 to 8:15 P.M.			
WABC	F. Sinatra Orch.	2.1	2.5
WEAF	Maxwell Coffee Time	16.7	14.2
WHN	H. Horlick Orch.	.4	—
WINS	Misc.*	.1	—
WJZ	Earl Godwin	1.3	2.5
WMCA	News, Bond Wagon	.5	—
WNEW	Hollywood Pass Time	1.1	.8
WOR	Sinfonietta	1.9	2.5
WOV	News, 1280 Club	1.6	1.7
WQXR	Symphony Hall	1.1	.8
Misc.		.9	—
Sets-in-Use		27.5	25.0
No. of Interviews		1,200	120

* Off the air September and October.

is an absence of any serious inflation of "big name" shows in the roster results (Kate Smith and Coffee Time) and certainly the less well known programs receive ratings by the roster method. In other words, people do remember listening to these little known shows. Indeed, there are many instances where the coincidental rating finds no listeners, but the roster does.

These results lend further substantiation to the usefulness of the roster method for the measurement of the radio audience. This technique makes it possible for a small number of personal roster interviews to do a measurement survey which would require many more times this number if personal coincidental interviews were made. For example, in New York City, by making 6,300 roster interviews, and in each interview obtaining a record of listening over 24 quarter hours, a measurement of the radio audience is made which would require 151,200 personal coincidental interviews. This number of interviews would be prohibitive in terms of cost and in terms of time. The sample of 6,300 roster interviews, divided into 21 sub-samples of 300 each, has been determined to yield sufficient statistical adequacy for monthly radio measurement since the standard error of the ratings vary from .575 per cent for a 1 per cent rating to 2.89 per cent for a 50 per cent rating (6).

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Reading Deficiency as Related to Cerebral Injury and to Neurotic Behavior

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However one may specifically measure reading performance, any demonstrable behavioral deficiency in reading may be the result of any of several different factors, singly, or in various combinations. The major possible causes are: 1. Technical and attitudinal deficiencies of teachers of reading; 2. emotional block centering on the reading process or somehow associated with it; 3. general intellectual deficiency (whether developmentally slow, arrested, or regressive); 4. organic impairment (whether sensory, motor or integrative, and whether inherited, congenital, or acquired by accident or disease, and whether local or general). This discussion is concerned only with the relations of measured reading deficiency with the 2nd and 4th of these factors. It is recognized, of course, that in actual cases these factors cooperatively determine reading behavior and that there is mutual inter-action among them.

By definition for the present paper we shall refer to those instances of reading deficiency whose primary cause is organic as reading *disability*. The term reading *inability* for those cases depending on emotional and intellectual factors.

Furthermore, reading *disability*, an impairment of the mental processes (visual, auditory, vocal) most used in reading, rests upon a structural impairment (Warren 14). These are not the only mental processes involved in reading. Reading more nearly involves the entire mental organization of the individual than is commonly supposed. For example, kinethesis is used in eye movements and in vocalizations. Also, it is likely that the cerebrum operates very much as a unit in "advanced" reading. Furthermore, virtually the entire "apperceptive mass" of sets, memories, stimulus-response associations, etc., participate in reading behavior.

This definition results from more than two thousand hours of indi-

[1] The author was inclined to credit all reading failure to faulty instruction when he began work in this field. Actually most children with reading *disability* had received more, and, probably better instruction in reading than was received by the generality of children from comparable social backgrounds, that is, better in the sense of the technical proficiency of the teaching, not of course, in the wider psychological sense.

vidual work with children [1]: (*a*) of good health, (*b*) of better than average academic opportunity, (*c*) with more than average "encouragement" to read, (*d*) with neither ocular nor aural defects, (*e*) whose achievements in reading were significantly inferior to their achievements in other fields, and (*f*) for whom all available data show relative incapacity for reading, i.e., capacity for reading as compared with capacity in fields not involving reading, or in which reading is of minor importance.

The term "neurotic behavior" is used as defined by Maier (10), Cook (1), and other investigators of "experimental neurosis." These data indicate that children with reading *disability* who develop neurotic behavior do so because of "frustration," and that the life situation of a child who cannot read but is forced to try, who fails and is aware of failure, is a "frustration" of the "no-solution" type. For purposes outside the scope of this paper there remain those instances where "frustration" engenders the deficiency in reading but these, according to our definitions, are instances of *inability*, whereas the concern herein is with *disability*.

Structural impairment is inferred from functional impairment. Our data suggest an etiology of cerebral injury, milder, but similar to that described by Doll, Phelps, and Melcher (3). Their discussions of obscure effects of "birth injury" have become increasingly meaningful to us as we have dealt concurrently with known birth trauma cases having motor dysfunctions and with cases of reading *disability*. They say: "The fact that a number of neurologists have included in the birth-trauma group defective children who show no motor handicap is of itself enough to show the insufficiency of the motor handicap as the entire explanation of the mental retardation" (p. 13) and ". . . there is reason to believe that cases of mental retardation which show no motor difficulties may be attributed to birth trauma" (p. 6). In view of the dangers of cerebral injury from toxins, contusions, and strangulations, after, as well as prior to, birth, the functional impairments common to reading *disability* appear as resulting from "brain injury," probably, but not necessarily experienced at parturition.

Findings

It was not possible to secure adequate records of conditions attending births for many reading *disability* cases.[2] The reports available indicate more-than-average difficulty of delivery. Twelve of twenty-two are first born, twenty-one of the twenty-two are boys, eleven have peculiarities of

[2] It is doubtful that medical records would describe injuries of this type, either because of failure of physicians to observe them or because they considered it inadvisable to report them. Mothers' reports of difficulty of parturition, method of delivery, and of injury at birth, are, at best, inaccurate.

gait, twenty have minor speech difficulties, two are severe stammerers, all have faulty ocular coordination, and twenty of the twenty-two are deficient in auditory discrimination.

Certain similarities between the behavior of individuals with motor dysfunction resulting from "birth injury" and those with reading *disability* became apparent to us only within the past few years. When perceiving, it appears that both types of cases are trying to do something too difficult for them—as though they are trying to lift an object which they can move slightly but cannot quite lift. In recall and recognition, it is as though they are aware of having had the experience before but cannot clarify the details—more of an aphemia than of an amentia. With the motor-disabled, it might be moving a glass of water from one position to another without tremor. With cases of reading disability it might be determining whether the last letter of an exposed word is *m* or *n*, or whether the final sound of a word is *in* or *ine*.

Similarities between reading disability and motor disability resulting from "birth injury" emphasize the necessity of a rigorous examination of all children who do not learn to read in the course of normal instruction. The same care should be exercised in examining for reading disability as Doll (3) has shown is essential in examining for mental deficiency. Reading *disability* is commonly confused with reading difficulty or with reading *inability* because of a naive faith in test scores. Young's (16) diagnosis of "reading disability," from a forty-two months difference between scores on reading and on intelligence tests, is inadequate as will be shown later in this paper. Much of the difficulty encountered by teachers of remedial reading is due to failure to differentiate between the child who has reading disability and the one who does not learn to read simply because he has not studied reading, or because of emotional conflict, or because of intellectual deficiency.

Relation to Emotional Blocking

Inability to read following normal instruction is not conclusive evidence of reading disability. Some children do not learn to read because they are "dull," but others fail because they do not study reading, even though they go to school. In reality this is also the case with children who do not learn to read because of emotional imbalance since in such cases their energies are not properly mobilized. Example: John (data not given in table) [3] came to us when he was 13 years, 5 months old. He scored about four years below his age level in oral reading and two

[3] Detailed data for twenty-two cases of reading *disability* are given in Table 1. Numbers in parentheses following the names of cases discussed refer to case numbers in Table 1.

years below in silent reading. Non-verbal intelligence test scores approximated his age level. There was no evidence of reading *disability*—only of *inability*. John had entered a "traditional" first grade at the age of 61 months. He did not learn to read and quit trying. We believe that he was too immature for reading when he first undertook the study and had developed a serious "neurosis" relative to reading. After five months of conventional tutoring in reading his attainment approximated that of his age level. During this period parents, teachers, and child were impressed with the fact that John was not stupid and that he could learn to read, indeed, must learn to read in spite of his tears. Thus, excess sympathy and equivocation were replaced by understanding firmness.

Reading disability is found at all levels of mental ability as measured by present-day intelligence tests. Some children with reading disability are so "dull" that clinical instruction is a hopeless task; some are "gifted" in nearly everything but reading. Examples: Clarence (No. 20) and Clifton (No. 19) at seventeen and fourteen years of age, respectively, could do ordinary manual labor but had not learned to read beyond a first grade level despite eight or nine years of schooling and a great deal of tutoring. They had all the impairments of function common to reading disability as well as general mental retardation. Binet I.Q.'s were 60 and 63 respectively. Non-verbal intelligence test scores were equivalent to Binet test scores. Powers of retention were inadequate for mastery of reading by clinical procedures in both cases. Example: Adam (No. 4) came to us at the middle of his junior year in college. He had never failed a course though he had never read a high school or college textbook because he couldn't. His non-verbal intelligence test scores were exceptional. Both oral and silent reading test scores were at an eleven year level. Adam had survived in college by listening carefully, attending "quiz" sessions, and by "bluffing." Subsequent to clinical instruction (about 60 hours) he completed his college course with no grade below a "B" and graduated from a professional school.

Reading disability is not feeblemindedness, though it may simulate mental deficiency. Example: Philip (No. 1) came to us when he was 13 years, 10 months of age. He was in the sixth grade, made a Binet I.Q. of 78, and was classified as "Borderline" by his school. His scores on Gray's Oral Reading Paragraphs and on the New Stanford Reading Test were at a second-grade level. He scored 85 on the Revised Beta Examination, an age equivalent of 14 years, 6 months. He was earning about five dollars per week selling newspapers and magazines, did excellent mechanical work and gave no evidence of "dullness" except in reading. There was no question about his inability to learn to read by

Table 1

Data for Twenty-two Cases of Reading Disability *

(Cells marked with X's indicate presence of the conditions, blank spaces their absence)

Case No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Sex	M	M	M	M	M	M	M	M	M	M	F	M	M	M	M	M	M	M	M	M	M	M
Order of Birth	2	1	1	1	1	1	1	3	2	1	1	2	2	2	1	1	1	2	2	1	1	3
Age (Months) †	178	128	156	243	167	164	148	126	94	91	288	218	103	132	168	170	108	120	169	213	122	154
School Grades Repeated	2	1	2	0	1	1	1	1	0	0	2	0	0	0	1	1	1	0	3	3	1	2
Verbal Intelligence	149	116	156	194	98	100	172	112	96	114	122	170	103	105	173	186	107	122	98	114	116	72
Non-verbal Intelligence	178	129	206	216	156	178	204	126	142	126	A	A	120	166	188	197	129	156	110	131	168	144
Oral Reading	100	72	122	132	118	122	131	88	107	72	100	A	72	86	141	156	91	96	72	72	89	84
Silent Reading	100	72	129	142	127	143	154	113	100	72	120	170	72	111	163	181	94	96	72	72	104	121
Spelling	80	72	120	132	120	126	120	92	96	72	120	118	72	107	131	140	90	105	72	72	104	89
Computation	125	98	141	A	130	159	140	122	120	90	A	120	102	145	139	198	92	92	102	108	158	114
Ocular Defects																						
Aural Defects																						
Peculiarities of Gait	X			X		X				X	X		X	X	X				X			
Minor Speech Difficulties		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Major Speech Difficulties	X										X											
Auditory Impairments	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Visual Impairments	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Preferred Hand	R	L	R	R	R	R	R	R	R	R	R	R	L	R	R	R	L	R	L	R	R	R
Dominant Hemisphere ‡	L	R	L	L	L	L	L	L	L	L	R	L	R	L	L	R	R	R	R	L	L	L
Timid	X			X		X		X	X	X	X	X		X	X						X	X
Bellicose		X	X		X								X				X				X	X
Hyperactivity	X	X	X	X	X	X		X	X	X	X			X	X	X	X				X	X
Tics	X			X				X		X	X			X	X							X
Chronic Fatigue	X			X		X		X		X	X			X	X							X
Frequent Headaches	X		X	X	X	X		X		X	X			X	X							X
Chronic Indigestion	X			X		X		X		X	X			X	X		X					X
Faulty Circulation	X			X		X		X		X	X	X		X	X							X
Poor Appetite	X			X				X		X	X			X	X							X
Chronic Constipation	X			X		X		X		X	X			X	X				X			X
Poor Sleep	X			X				X		X	X			X	X							X
"Nagged" at Home	X			X	X	X		X		X	X			X	X	X						X
Indifference at Home		X					X					X										
Approval at Home			X						X				X				X	X	X	X	X	X
Feelings of Success		X	X		X		X		X			X	X			X						
Neurotic	X			X	?	X		X		X	X	?		X	X	?						X

* These data come from a wide variety of intelligence and achievement tests. Where two or more tests of the same function were used with an individual the scores are averaged. We have attempted to give a "clinical" description of the cases without elaborate detail. All original test and observational data are in our files.

† Age and test data are given in months. Where this is not done, letter ratings, A, B, C, D, E, are given.

‡ Data on laterality were secured by following the procedures of Jastak (6) and Monroe (9).

conventional methods. His grandmother, an experienced teacher with whom he was in excellent rapport, had tutored him for years. Subsequent to clinical instruction (about 100 hours) he graduated from high school and is now doing well in a skilled trade.

Behavior Characteristics Associated with Reading Disability

Reading disability has four major characteristics: (*a*) impairment of perception, recognition, and recall of the configurations employed in writing; (*b*) impairment of perception, recognition, and recall of exogenous sounds, particularly of combinations; (*c*) impairment of perception, recognition, and recall of the phonetic components of auto-vocalizations; and (*d*) impairment of the motor groups involved in reading (i.e., visual and vocal).

The extent and nature of impairment determine the severity of reading disability. Silent reading is affected more by visual than by auditory impairment. Auditory and motor impairments are additional handicaps in oral reading. If the impairment is non-visual it may never be detected in the present-day school because of the greater emphasis given to silent than to oral reading. The more "intelligent" the child, the better he can conceal his disability if he wishes.

Every case of reading disability examined had impaired visual perception-for-reading. Not one was able, consistently, irrespective of age, to perceive (discriminate) the letters *b*, *d*, *p*, *q*, *m*, and *n*, either binocularly or monocularly. None had greatly defective eyesight, though some wore glasses. Faulty recognition and recall of visual stimuli were as prevalent as was faulty visual perception. During clinical instruction, difficulties in recognizing a letter, syllable, or word as having been perceived previously, in getting the meaning, and in recalling the situation in which it had been read, persist long after perception for that configuration was satisfactory.

Similarly, persistence of difficulty is less marked in perception than in recognition and recall of both exogenous and endogenous phonetic articulations. Twenty of the twenty-two cases had impaired auditory perception, recognition, and recall. All tested within the range of normality on the audiometer for the entire frequency range. Of twelve cases examined with the Moosehart Test for Phonetic Discrimination, none scored "normal."[4] Confusion with respect to auto-vocalizations is found to be, for the child, the most disconcerting aspect of reading disability. Even phonographic reproductions of their speech can scarcely convince some of their own errors of pronunciation.

[4] This test is not sufficiently refined for detailed analysis. The time interval between presentation of successive stimuli does not make sufficient demands upon powers of retention, recognition, and recall.

The past ten years have produced a wealth of data on the faulty eye movements of poor readers. With reading disability these are accentuated. It seems that some individuals have virtually no control of eye movements for reading, particularly when emotionally disturbed. All have erratic eye movements and experience extreme difficulty in fixating for perception. Even after clinical instruction, and with reading test scores equivalent to scores on non-reading tests, these impairments persist. It is more likely that these motor impairments result from cerebral impairment than that the motor impairments are mere impediments to cerebration, or that they are consequences of any emotional disturbance. No amount of training will correct, entirely, the motor dysfunctions of those with severe reading disability.

Using Monroe's (12) and Jastak's (8) tests of laterality we find no relationship between cerebral dominance and reading disability. Many cases of reading disability test as having complete cerebral dominance and many excellent readers test as having incomplete brain dominance. A person who has a reading disability, and a lack of clear cerebral dominance, however, appears to be under a special handicap.

Impairment of motor function for vocalization is found to be common to reading disability. It is similar, in many ways, to the disturbances of stutterers described by Hendrickson (7). How much of the difficulty in vocalization results from emotional imbalance was uncertain. It proves more amenable to correction than do faulty eye movements, though some of it survives extended clinical instruction.

Relation to Neurotic Behavior

Neurotic behavior associated with reading disability is not different from the neurotic behavior of those who do not have reading disability. The child who is timid before failure in reading "withdraws" more as failure becomes more evident and as "pressure to read" is applied more vigorously. The bellicose child becomes more belligerent as his reading disability becomes more evident and as he experiences more social disapproval because of his failures. The belligerent child with reading disability who becomes neurotic, while more of an immediate social problem (he is harder to get along with), is less seriously neurotic than the timid child with reading disability who becomes neurotic. The neurotic behavior of the individual with reading disability usually is characterized by: withdrawal and secretiveness or belligerency and general social incompetence in situations not immediately connected with reading, hyperactivity, tics, attempts to avoid exposure of failure, chronic fatigue, headaches, indigestion, blurred vision, moist and clammy extremities, frequent urination, and generally abnormal involvement of the

sympathetic and parasympathetic nervous systems in situations closely allied with reading, loss of appetite, constipation, faulty sleep, including dreams and nightmares, and serious consideration of suicide.

The child who secures major satisfactions without reading does not develop serious neurotic behavior, no matter how serious his reading disability may be. It makes no difference whether his activities be social, unsocial, or antisocial as long as he is approved by his immediate group, particularly by his family, so that failure to read is not a highly significant part of his experience.

Of twenty-two cases of reading disability, nine are seriously neurotic, ten not neurotic, and three doubtful. Investigations subsequent to initial examinations reveal that every individual classed as seriously neurotic had a family background of nagging and fault finding or of incessant urging toward academic success with no satisfactory means of self-expression, or of both nagging and prodding. Every case of reading disability classed as non-neurotic had a background of sympathy and encouragement or of indifference toward academic success, or lacking these, had activities with which he was engrossed and at which he considered himself successful. Thus the reading disability is not the prime cause of the neurotic behavior (it is neither a necessity nor a sufficient condition), but rather offers a focal point of opportunity for the operation of the typical psycho-social causes of neurotic behavior. Example: Leo (No. 14) was suspected of having chorea. He was 11 years, 0 months of age when he came to us. He walked awkwardly, moved incessantly, and had severe tics involving most of the face, neck and shoulders. He slept poorly, was chronically tired, and had severe headaches, indigestion, constipation, and appeared "about ready to explode." He was in the fifth grade, doing very poor work in everything but computation and had been passed from grade to grade because of the social prominence of his parents. His school record showed failure in reading, beginning with the first grade and becoming more pronounced as he passed from grade to grade. Achievement in arithmetic had been excellent until reading became important to that subject. Leo was accelerated 2 years, 9 months on non-verbal tests of intelligence and retarded 1 year, 3 months on verbal intelligence tests. Oral reading was retarded 3 years, 11 months, silent reading, 1 year, 10 months, spelling, 2 years, 2 months, and arithmetic 1 year, 0 months. Sound discrimination, sense of pitch, and memory for tones were very poor. Leo had extreme reading disability and severe neurotic behavior. He was shy, withdrawn, secretive, and generally disturbed emotionally. He was nagged continually over his poor school work and had been told, both at home and at school, that he was stupid. His father was indulgent but critical and harsh. He shouted at, slapped, and humored the boy. He told Leo that he was no

good and lectured him on how to become as great a man as his father. Leo was accused of being lazy because he did not work interminably at tasks that he could not perform. Learning to read altered his behavior in relation to reading though he continues to react neurotically to the emotional outbursts of his father. Example: Peter (No. 18) was ten years of age and had reading disability comparable to Leo's when he came to us. He was much more stable emotionally than the average boy of his age. He had a comfortable home environment and though thoroughly aware of his deficiencies in reading he had no marked emotional concern over them. He had received more-than-average encouragement to read, but little criticism because he was unable to do so.

Of the three types of behavior associated with reading disability (neurotic, non-neurotic, and indifferent) the non-neurotic is most favorable to correction and indifference is least favorable. It is easier to correct the child's neurotic behavior as related to reading disability and then teach him to read than to overcome indifference or lack of desire to learn. If a child with reading disability is neurotic, usually, it is because of the unrelenting pressure exerted to get him to read when he is incapable of reading, though some children with reading disability become neurotic in relation to other "frustrations." The child who has reading disability but lacks interest in reading is unlikely to make the tremendous effort essential to correction of his disability. In actual practice it is found that such cases respond better if sufficient pressure can be applied to make them slightly "neurotic." It appears easier to correct a mild neurosis than to combat apathy.

Finally, it may be noted that although our cases are those wherein neurotic behavior derives from the basic condition of reading disability, they also demonstrate the principle referred to earlier in this paper in that once the "frustration" of reading disability produces neurotic behavior, then the emotional up-set in turn may interfere with a hygienic approach to reading, thus producing a secondary reading inability. Hence the need for clinical procedures which attack both factors, i.e., specific training in reading technique, plus psychotherapeutic procedures for the relief of the induced personality disturbance. Indeed, this combination of remedial effort is in order for virtually all types of disorders of the reading function whatsoever the pattern of causation.

By "clinical procedures" is meant the following various operations, allowing that the procedures differ according to the needs of each individual, that is, in certain instances one technique would precede another, in others they might parallel one another, but in all cases there are two main attacks on the problem: (1) psychotherapeutic; and (2) specific reading re-education.

The psychotherapeutic approach frequently consists of securing the

child's cooperation, of getting him to relax, to concentrate, or to adopt whatever attitudes are needed, and of modifying parental and teacher attitudes. Reading re-education is accomplished mostly by the so-called "analytic" approach to the teaching of reading. The child is taken back to the earliest phases of reading and carefully taught letters, syllables, words and phrases and the basic rules of spelling, pronunciation and grammar. Finger tracing and writing, using the preferred hand, is employed in the primary stages of instruction. Guide lines, finger pointing, and time-exposure devices are used in more advanced training. We use every "prop" at our command to the extent that seems advisable, insisting upon their use until the fundamentals of reading are mastered, and leaving the child free to discard them, thereafter, when he no longer feels a "need" of them.

It is not established that this approach is better or worse than some other particular method, nor is it known whether the responsibility for improvement lies more with the remedial instruction, *per se*, or with the direct and indirect influences of the personal relation between psychologist and child (i.e., psychotherapy). In all cases the remedial instruction is necessary, of course, though possibly other particular methods would also work successfully. In some cases, especially those diagnosed as "neurotic," the psychotherapy is especially necessary in order to prepare the child to receive instruction in reading. In a number of cases the psychotherapy is quite indirect in that it is not accomplished by frontal attack, but rather derives from the psychologist's attitudes to the child and to his parents and teachers during the teaching process. In some cases the psychologist alone works with the child, the child being removed from school to "shield" the child from any other instruction in reading. In other cases the child remains in school and the psychologist, in addition to working with the child, guides the child's teacher, both as to specific techniques of remedial reading instruction, and as to attitudes and setting to be adopted. In these cases the teacher supplements the psychologist's role both in specific remedial education and in psychotherapy. In virtually all cases the parents supplement and/or implement the role of psychologist as therapist and occasionally as teacher of reading.

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Book Reviews

Darley, John G. *Testing and counseling in the high school guidance program*, Chicago, Illinois: Science Research Associates, 1943. Pp. 222.

In a field in which there has been much recent publication, one's first question concerning a new book is, what does it do that hasn't already been done? The answer, for Darley's new text, is that although it covers familiar topics and material, it does so in a manner which should make it appeal to the high school teacher starting out in vocational guidance. While not a book for the specialist, it is one with which specialists should be familiar, for it presents the methods of testing and test interpretation in a context and manner which help to make them seem valuable and practical to the non-psychologically trained persons who now carry the burden of such vocational guidance as is available to most high school students.

The book is at once a text on testing and a text on counseling procedures, but it does not deal in great detail with either topic. It would make a good text for a first course in testing or counseling for non-psychologists, following a basic course in the principles of vocational guidance. However, many of Darley's statements and his underlying philosophy do much to misrepresent the objectives and methods of guidance and counseling, in line with two fallacies revealed in a number of the Minnesota publications. The first Minnesota fallacy arises, as this reviewer sees it, from the very excellence of much of the work done there in the development of tests and of the use of objective techniques: too great an emphasis is put on the role of tests. The second fallacy stems from this, for the test interpreter becomes a judge and maker of decisions for the student, rather than a counselor or teacher who helps the student to develop insight and make his own decisions.

Thus, whereas Darley's title is "Testing and Counseling," what he appears to mean is "Diagnosis and Counseling," as indicated by the statement that this book is written for those "who want to understand what to expect of counseling." The implication is that diagnosis is based so largely on testing that other methods, briefly discussed, are of minor importance. This reviewer would be one of the last to decry the use of tests, but it would be unfortunate were they to be assumed to be the essence of counseling, as is so often done by teachers and laymen.

This is especially so in view of the second fallacy, namely the assignment of the role of decision maker to the counselor. If testing is the

essence of counseling and the counselor alone understands testing, the counselor, in his superior wisdom, must decide what is wise and what is unwise. This fits in with a common misconception of guidance, instead of revealing the counseling process as one in which a knowledgeful person assists a less-informed individual to acquire needed insight and to make appropriate decisions. Darley's undemocratic philosophy is illustrated by a paragraph on p. 169: "In many respects, the interview seems somewhat similar to a sales situation, since the counselor attempts to sell the student certain ideas about himself, certain plans of action, or certain desirable changes in attitudes. Persuasion and logic will facilitate and hasten the sale of such ideas by a counselor." But will the student be any better equipped to solve problems himself, or any happier with his new adjustment, assuming he brings it about?

Fundamental though these philosophical defects are, they do not affect the other excellent features of Darley's text. Chapter I deals with the place and possibilities of guidance in education. Chapter II consists of a brief but interesting discussion of what one should know about students, how these factors operate and why they are important—it is a good interest-arouser and is not limited to test data. Chapter III deals with statistics in an easily understood and breezy manner; it is on the whole admirable for beginners, and certainly necessary at present in such a text, but one wishes for the day when all would-be students of testing will be expected to know elementary statistics.

The crucial topics of selecting and using specific tests are covered in Chapter IV in about forty pages. Darley judiciously selects two or three tests in each area; unfortunately, they are too briefly discussed. The Minnesota Vocational Test for Clerical Workers is covered in half a page, the Kuder Preference Record in one page. More data are needed on norms and on interpretation: for instance, the reader is referred to Strong's manual for data on the validity of his interest blank, essential to its interpretation. It is to be regretted that psychologists who have done as much test construction and have stressed the clinical approach as much as the Minnesota group have not written at greater length on the clinical interpretation of specific tests—as Darley himself has elsewhere on Strong's Interest Blank. The discussions of interest and personality testing in general are very good, with judicious caution urged in the latter area, each receiving about five pages; intelligence, achievement, and aptitude are less well treated both quantitatively and qualitatively.

Chapter V deals briefly with starting a counseling program. In Chapter VI diagnosis is dealt with in a manner reminiscent of other Minnesota publications.

The counseling process is discussed in Chapter VII, in which the

Minnesota viewpoint on active therapy is expressed. The interview is appropriately called a learning situation. Learning may be sought by lecture or recitation (both dismissed as ineffective), discussion (approved but not discussed at sufficient length), or explanation of data followed by discussion. The last-named technique is called the best. While this is true in many short-term vocational counseling cases seen by clinic counselors, it is probably not true of others, and this reviewer believes there are better techniques for use in a school situation where time is available for long-term counseling. These involve discussion of a question-asking type which stimulates the student to seek information, some of which is obtained by means of tests and some by means of other experiences, and which also leads him to suggest and evaluate interpretations, thus helping him to develop techniques of self-guidance rather than habits of depending on others for specific advice.

The last chapter is an admirable account of the development of a community, county, and state-wide counseling program of a type happily becoming increasingly common. Publication of such accounts is a help both as stimulation and as guide for other communities.

Despite its defects of philosophy, brevity of treatment of specific tests and of counseling techniques, and relative neglect of non-testing sources of diagnostic data, this is a useful book. It will be valuable, when properly supplemented, in elementary testing courses and in introductory counseling courses in which it is necessary to survey testing techniques.

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New Books, Monographs, and Pamphlets

Child development through the school years. Marian E. Breckenridge and E. Lee Vincent. Philadelphia: W. B. Saunders Company, 1943. Pp. 592. $3.25.

Borderlands of psychiatry. Stanley Cobb. Cambridge: Harvard University Press, 1943. Pp. xiv + 166. $2.50. (Harvard University Monograph in Medicine and Public Health No. 4.)

The boy sex offender and his later career. Lewis J. Doshay. New York: Grune & Stratton, Inc., 1943. Pp. 248. $3.50.

Mental hygiene in school practice. Norman Fenton. Stanford University: Stanford University Press, 1943. $4.00.

Psychology of adolescence. Karl C. Garrison. New York: Prentice-Hall, Inc., 1943 (Revised Edition). Pp. 477. $3.00.

Stuttering: significant theories and therapies. Eugene F. Hahn. Stanford University: Stanford University Press, 1943. $2.00.

Complexity of mental processes in science testing. Frederick T. Howard. New York: Bureau of Publications, Teachers College, Columbia University, 1943. Pp. 54. $1.75. (Contributions to Education No. 879.)

Leadership and isolation. Helen H. Jennings. New York: Longmans, Green and Co., Inc., 1943. Pp. 240. $3.00.

Child psychology. Arthur T. Jersild. New York: Prentice-Hall, Inc., 1943. (Revised) Pp. 592. $3.00.

Maternal overprotection. David M. Levy. New York: Columbia University Press, 1943. Pp. xiii + 417. $4.50.

How to pass a written examination. Harry C. McKown. New York: McGraw-Hill Book Co., Inc., 1943. Pp. 165. $1.50.

Structural visualization. Johnson O'Connor. Boston: Human Engineering Laboratory, 1943. Pp. 189. $2.00.

The too-many-aptitude woman. Johnson O'Connor. Boston: Human Engineering Laboratory, 1943. Pp. 191.

Unsolved business problems. Johnson O'Connor. Boston: Human Engineering Laboratory, 1943. Pp. 165.

Personal leadership for combat officers. Prentiss B. Reed. New York: McGraw-Hill Book Co., Inc., 1943. Pp. 116. $1.50.

Measurement in today's schools. C. C. Ross. New York: Prentice-Hall, Inc., 1943. Pp. 597. $3.25.

Children with delayed or defective speech. Sara M. Stinchfield and Edna H. Young. Stanford University: Stanford University Press, 1943. $2.50.

Child psychology for professional workers. Florence M. Teagarden. New York: Prentice-Hall, Inc., 1943. Pp. 641. $3.25.

Contemporary psychopathology. Silvan S. Tomkins. Cambridge: Harvard University Press, 1943. Pp. 528. $5.00.

Improve your reading. Frances O. Triggs. Minneapolis: The University of Minnesota Press, 1943. Pp. 127. $1.00.

Remedial reading. Frances O. Triggs. Minneapolis: The University of Minnesota Press, 1943. Pp. 250. $2.50.

The effects of flight—physical and mental aspects. New York: McGraw-Hill Book Co., Inc., 1943. Pp. 125. $.60. (Flight Preparation Training Series.)

Errata

In the October issue of the *Journal of Applied Psychology,* attention was called to the fact that the May 1943 issue of the *Bulletin* of the Menninger Clinic, Topeka, Kansas, is devoted to clinical psychology. The price of this issue was listed as 15 cents each. This was an error. The price is 50 cents each.

AMERICAN PSYCHOLOGICAL PERIODICALS

American Journal of Psychology—Ithaca, N. Y.; Cornell University. Subscription $6.50. 624 pages annually. Edited by K. M. Dallenbach, Madison Bentley, and E. G. Boring. Quarterly. General and experimental psychology. Founded 1887.

Journal of Genetic Psychology—Provincetown, Mass.; The Journal Press. Subscription $14.00 per annum (2 volumes). 1000 pages annually. Edited by Carl Murchison. Quarterly. Child behavior, animal behavior, and comparative psychology. Founded 1891.

Psychological Review—Northwestern University, Evanston, Illinois; American Psychological Association, Inc. Subscription $5.50. 540 pages annually. Edited by Herbert S. Langfeld. Bi-monthly. General psychology. Founded 1894.

Psychological Monographs—Northwestern University, Evanston, Illinois; American Psychological Association, Inc. Subscription $6.00 per volume. 500 pages. Edited by John F. Dashiell. Without fixed dates, each issue one or more researches. Founded 1895.

Psychological Bulletin—Northwestern University, Evanston, Illinois; American Psychological Association, Inc. Subscription $7.00. 665 pages annually. Edited by John E. Anderson. Monthly (10 numbers). Psychological literature. Founded 1904.

Archives of Psychology—New York, N. Y.; Columbia University. Subscription $6.00 per volume. 500 pages. Edited by R. S. Woodworth. Without fixed dates, each number a single experimental study. Founded 1906.

Journal of Abnormal and Social Psychology—Northwestern University, Evanston, Illinois; American Psychological Association, Inc. Subscription $5.00. 560 pages annually. Edited by Gordon W. Allport. Quarterly. Founded 1906.

Journal of Educational Psychology—Baltimore, Md.; Warwick & York. Subscription $6.00. 720 pages annually. Edited by J. W. Dunlap, P. M. Symonds, and H. E. Jones. Monthly except June to August. Founded 1910.

Psychoanalytic Review—New York, N. Y.; 64 West 56th St. Subscription $6.00. 500 pages annually. Edited by Smith Ely Jelliffe. Quarterly. Founded 1913.

Journal of Experimental Psychology—Northwestern University, Evanston, Illinois; American Psychological Association, Inc. Subscription $14.00 per annum (2 volumes). 1040 pages annually. Edited by Samuel W. Fernberger. Monthly. Founded 1916.

Journal of Applied Psychology—Northwestern University, Evanston, Illinois; American Psychological Association, Inc. Subscription $6.00. 480 pages annually. Edited by Donald G. Paterson. Bi-monthly. Founded 1917.

Journal of Comparative Psychology—Baltimore, Md.; Williams & Wilkins Co. Subscription $14.00 per annum (2 volumes). 1000 pages annually. Edited by Roy M. Dorcus. Bi-monthly. Founded 1921.

Comparative Psychology Monographs—Baltimore, Md.; Williams & Wilkins Co. Subscription $6.00 per volume. 400 pages. Edited by Roy M. Dorcus. Without fixed dates, each number a single research. Founded 1922.

Genetic Psychology Monographs—Provincetown, Mass.; The Journal Press. Subscription $7.00. 500 pages annually. Edited by Carl Murchison. Bi-monthly. Each number one complete research. Child behavior, animal behavior, and comparative psychology. Founded 1925.

Psychological Abstracts—Northwestern University, Evanston, Illinois; American Psychological Association, Inc. Subscription $7.00. 700 pages annually. Edited by Walter S. Hunter and H. L. Ansbacher. Monthly. Abstracts of psychological literature. Founded 1927.

Journal of General Psychology—Provincetown, Mass.; The Journal Press. Subscription $14.00 per annum (2 volumes). 1000 pages annually. Edited by Carl Murchison. Quarterly. Experimental, theoretical, clinical, and historical psychology. Founded 1927.

Journal of Social Psychology—Provincetown, Mass.; The Journal Press. Subscription $7.00. 500 pages annually. Edited by John Dewey and Carl Murchison. Quarterly. Political, racial, and differential psychology. Founded 1929.

Psychoanalytic Quarterly—Albany, N. Y.; 372-374 Broadway. Subscription $6.00. 560 pages annually. Edited by Bertram D. Lewin and others. Quarterly. Founded 1932.

Character and Personality—Durham, N. C.; Duke University Press. Subscription $2.00. 360 pages annually. Edited by Karl Zener. Quarterly. Founded 1932.

Journal of Psychology—Provincetown, Mass.; The Journal Press. Subscription $14.00 per annum (2 volumes). 800–1200 pages annually. Edited by Carl Murchison. Quarterly. Founded 1936.

Psychometrika—University of Chicago, Chicago, Ill.; Psychometric Society. Subscription $10.00. 320 pages annually. Edited by L. L. Thurstone and others. Quarterly. Quantitative methods in psychology. Founded 1936.

Psychological Record—Bloomington, Ind.; Principia Press. Subscription $4.00. 500 pages annually. Edited by J. R. Kantor and C. M. Louttit. Without fixed dates, each number a single research. General psychology. Founded 1937.

Journal of Consulting Psychology—Lancaster, Penn.; Science Printing Co. Subscription $3.00. 240 pages annually. Edited by J. P. Symonds. Bi-monthly. Founded 1937.